December
2021

The Alabama Connectivity Plan

Prepared for:
Alabama Department of Economic and Community Affairs

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1 Executive summary

This document is the strategic plan for the Alabama Department of Economic and Community Affairs' (ADECA) new Alabama Digital Expansion Division (ADED).

During preparation of this plan, ADECA engaged with a wide range of service providers and stakeholders.[1] With additional input and consultation, this plan can be adapted to serve as the Alabama Digital Equity Authority's (ADEA) Connectivity Plan,[2] as established by the Connect Alabama Act,[3] to achieve goals that include:

- Facilitating the expansion of high-speed broadband
- Considering the need for broadband expansion in rural, underserved, and unserved areas
- Addressing obstacles to broadband adoption
- Developing funding strategies and plans for middle-mile and long-haul fiber, as well as last-mile infrastructure and services

This plan also aligns with the requirements for the opportunities created by the federal Infrastructure Investment and Jobs Act's broadband funding programs—though the rules for those program have not yet been released by the National Telecommunications and Information Administration (NTIA), so ADECA may need to do additional planning, depending on the final requirements.

1.1 The broadband availability challenge

The Alabama Broadband Map indicates that roughly 13 percent of Alabama's 1.65 million addresses are unserved by broadband of at least 25 Mbps download and 3 Mbps upload (25/3, the FCC's current benchmark speed), while about **19 percent of addresses are unserved by 100/20 service**—the threshold recommended as the State's five-year target to align with new federal funding opportunities (see Section 3.1). Higher-speed services like 100/100 and symmetrical 1 Gbps are available only to about 25 percent of addresses (Table 1).

[1] See Appendix A for a complete list.
[2] This plan should be updated in 2022 to reflect fast-changing federal funding requirements and new federal funding opportunities, including for the State's middle-mile needs.
[3] Connect Alabama Act (SB 215), https://arc-sos.state.al.us/ucp/L0623329.AI1.pdf (accessed December 28, 2021).

Table 1: Current status of broadband coverage in Alabama

	25/3	100/20	100/100	1000/1000
Number of unserved addresses (out of total of 1,649,535)	210,302	310,874	1,237,122	1,262,945
Percentage of total addresses that are unserved	12.7%	18.8%	74.99%	75.56%

Analysis of current Alabama Broadband Map data finds that census blocks across the State range from completely served to completely unserved at broadband speeds of 25/3 up to symmetrical gigabit. The maps below illustrate 25/3 and 100/20 service levels.

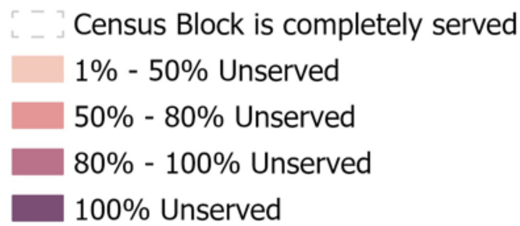


Figure 1: Unserved by 25/3

Figure 2: Unserved by 100/20

An engineering estimate of the effort needed to bridge Alabama's rural infrastructure gap finds that deploying 100/100 service to all addresses currently unserved by 100/20 would cost between $4 billion and $6 billion, with the lower number representing a best-case, baseline estimate. (See Section 3.1.2 and Appendix B.) An economic impact analysis suggests that this investment would deliver a wide range of impacts to Alabama (see Appendix D).

1.2 The broadband adoption challenge

Even where broadband infrastructure and services are available, they may not be attainable by all members of the community. A complex combination of factors—including affordability, device access, digital skills, and language barriers—can inhibit use of the broadband internet, to the detriment of both economic and community development.

Approximately 20 percent of Alabama households do not currently subscribe to broadband services, among the highest numbers in the region. The most commonly cited reason for not subscribing is cost, and awareness of federal subsidy programs is relatively low (though higher than in many neighboring states). This suggests that there exists considerable opportunity to increase use of broadband among Alabama households through outreach programs that assist low-income families to connect through new federal subsidy programs—to the benefit of the households, the State's public policy goals, and the ISPs that are paid by the federal government to serve those families.

1.3 Recommendations

This plan makes recommendations in five categories:

Broadband definitions and goals: Definitions enable alignment with federal policy and funds:

- **100/20**: "Broadband" is 100/20 service, delivered over terrestrial (not satellite) networks—and addresses that lack 100/20 service are "unserved"
- **100/100**: New infrastructure built with State funds should be capable of 100/100 and of scaling to higher speeds

Goals are designed to be measurable and achievable:

- **Five-year goal**: 90 percent of Alabama consumers and businesses will have access to 100/20 broadband service; this would cut in half the number of unserved locations
- **10-year goal**: 98 percent of Alabama consumers and businesses will have access to 100/20 over networks that are capable of cost-effective scaling to 100/100

Infrastructure and grant programs: The goal is to maximize the impact of public funds and attract private funds to bridge the considerable gap in rural Alabama. Recommendations are to:

- Expand and increase use of the existing grant program through strategic changes, designed to increase ISP interest and investment
- Develop a middle mile grant program to support last mile deployment and encourage research and innovation

- Develop a line extension grant program to fill unserved pockets within otherwise served areas
- Undertake twice annual analysis to align priorities with funding sources to maximize federal funding

Data and mapping: The goal is to use Alabama's leading broadband map to expedite the grant process, advocate for Alabama with the federal funding, and support Alabama ISPs in navigating federal requirements. Recommendations are to:

- Update The Alabama Broadband Map annually
- Expedite the grant program by enabling The Alabama Broadband Map to serve as the tool for ISPs to protect their interests, rather than through a time-consuming and cumbersome grant challenge process
- Support small Alabama ISPs with costly federal mapping obligations as necessary

State and local collaboration: The goal is to maximize the commitment and efforts of local government to address broadband, and to give them skin in the game. Recommendations are to:

- Support local planning and capacity building through technical assistance
- Support local communities to use local data and The Alabama Broadband Map to challenge the FCC map
- Allow local governments to contribute a portion of grant applicant match funds so as to give them opportunity to attract private partners, make private grant applications more viable, and efficiently use their ARPA and other dollars

Affordability and adoption: The goals are to increase use of broadband to improve economic outcomes, support lower-income households, and support ISPs. Recommendations are to:

- Develop and distribute (digital and analog) educational materials regarding subsidy program to public, educational, and non-profit entities statewide
- Staff a contact center in-state, to receive and make calls to eligible consumers to help them access subsidy programs, including the new federal Affordable Connectivity Plan, which has potential to provide internet to hundreds of thousands of Alabama families and support Alabama ISPs
- Develop grant program for digital skills training
- Work with Alabama ISPs to develop voluntary programs to support low-income broadband consumers

2 ADECA's efforts to date

Alabama's broadband efforts are regarded nationally as both path-breaking and exemplary. The State's industry-leading efforts include multi-year support for a robust grant program for internet service providers (ISP), an address-level map of statewide broadband availability, direct support to low-income students, and support for low-income families seeking to access ISPs' low-income programs and federal subsidies.

Notably, ADECA's efforts have included consistent, ongoing engagement with and outreach to partners and stakeholders. In particular, ADECA has developed superb working relationships with the ISP community, as is evidenced by the success of the State's grant program and the very high level of participation in The Alabama Broadband Map and the ABC for Students program.

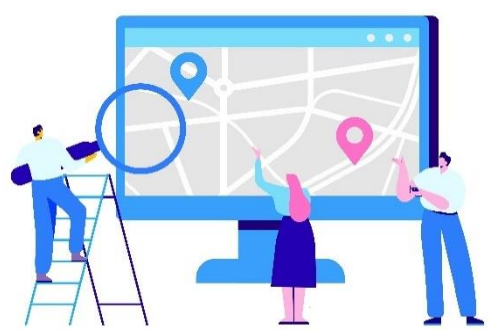
ADECA has also engaged with public sector stakeholders across the State—including ongoing outreach to local governments, collaboration with the associations that represent municipalities and counties, and engagement with other public and non-profit entities such as the Supercomputer and libraries.

2.1 Alabama Broadband Accessibility Fund grant program

ADECA's grant efforts have led the nation in many regards—particularly with respect to the duration of the existing grant program and its stability and continued support from Governor Ivey and the Legislature. The program has been consistent, methodical, and well-executed since Gov. Ivey signed the Alabama Broadband Accessibility Act establishing the fund in March 2018.[4]

Full details on the grant program, including funding allocations and grantees, are included in the annual report issued in December 2021.[5] The program offers a robust foundation for development of the next generation of grant programs as federal funds flow to the State to meet the needs of unserved areas.

2.2 The Alabama Broadband Map



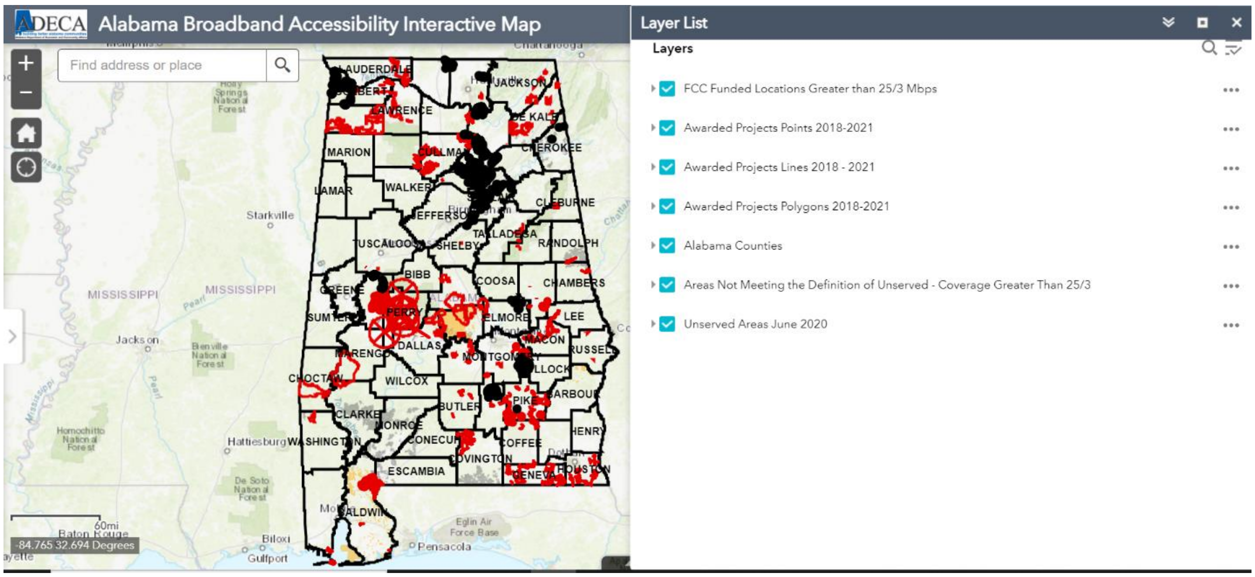
Based on an analysis of broadband maps throughout the country, ADECA is a national leader in broadband availability mapping and has one of the best maps of any state. This is due in part to the collaborative working relationship between ADECA and the ISPs of all sizes that serve customers in the State.

[4] "Grant Application and Implementation," ADECA, https://adeca.alabama.gov/grant-application-and-implementation/.

[5] "Alabama Broadband Accessibility Fund: Updated 2021 Annual Report (December 2021)," ADECA, https://adeca.alabama.gov/wp-content/uploads/Annual-Report-December-2021.docx.

ADECA worked in 2021 to create a statewide address-level broadband map to enhance policy-makers' ability to focus efforts on unserved areas (Figure 3). This effort recognizes that achieving the goal of connecting the unserved requires a granular understanding of broadband availability—and that the Federal Communications Commission (FCC) Form 477 data, which underpins the national broadband map, is inadequate and highly problematic because it overstates where broadband service actually is available.

Figure 3: Alabama Broadband Map



The Alabama Broadband Map was built with a rigorous multi-faceted methodology that included:

- Developing a unified dataset of the State's more than 1.6 million addresses in the form of an "address fabric" that is the foundation of the map
- Compiling and incorporating broadband availability databases from internet service providers in the State
- Conducting an online survey that garnered almost 23,000 responses
- Facilitating more than 16,000 speed tests statewide
- Conducting desk and field surveys to verify results

Notably, The Alabama Broadband Map represents not only data at the address level, but also an unprecedented level of participation by the ISP community. While a few very small ISPs did not provide data, the map effectively covers 100 percent of addresses in the State.[6]

The Alabama Broadband Map tracks coverage at the 25/3, 100/20, and 100/100 levels—the latter two of which are increasingly the thresholds on which Alabama policy-makers are focused.

The ADECA project team began the Map effort by developing an address "fabric"—essentially a database of every residence, business location, and other address in the State that needs broadband. Some states have that type of address data already, and the State of Alabama is developing it for E911 purposes—but it does not currently exist in Alabama.

The project team purchased the leading commercial database of this sort, then performed substantial work to widen and improve the fabric. While the fabric has limitations, and is not at the level of detail as will exist once the E911 database is in place, it is a strong underpinning for detailed broadband service analysis.

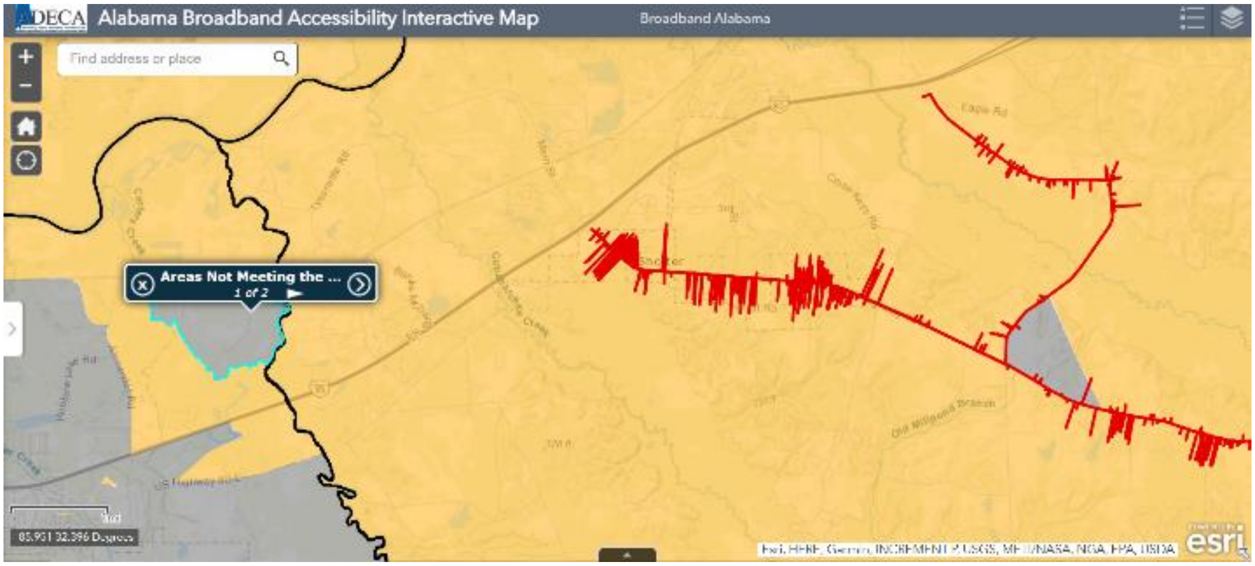
In developing the address fabric and data, ADECA conducted outreach to local and county governments, 911 authorities, and other public entities that had relevant data. The project team performed extensive data analysis to improve and maximize the fabric using those data.

ADECA also initiated a comprehensive outreach effort to engage ISPs operating in the State. The project team negotiated non-disclosure agreements (NDA) with each of the more than 70 currently active ISPs in the State; the NDAs protect the ISPs' proprietary business data and do not compromise their ability to compete with each other, but at the same time make it feasible for the ISPs to share their data with the State.

By negotiating access to those data, ADECA has enabled high-quality grant-making based on accurate data about which addresses are served and which are not; informed broadband policy-making; and the sharing of information with the public, who are deeply concerned about broadband access in their communities. (See Section 3.2 and Appendix C for key findings from a statewide survey of residents.)

[6] This kind of map is iterative and will require ongoing updates and improvement of the underlying map data.

Figure 4: Alabama Broadband Map – sample detail



Then through a series of processes, addresses were shared with the ISPs based on what general locations they serve; the ISPs, in turn, shared with ADECA lists of the specific addresses they serve and at what level of service. The ISPs frequently included additional information for the purpose of improving the Map's address data. ADECA will review and incorporate those data in the coming months.

The ADECA project team then analyzed the ISPs' address data, put into standard GIS format, and undertook multiple forms of vetting of the data, using a range of different automated and manual strategies. The project team evaluated data based on a random sampling of areas, then a strategically selected sampling of areas at the edges of ISPs' footprints.

The vetting mechanisms included automated software-based querying of ISP websites to determine whether a service could be purchased. The manual efforts included desk surveys by engineers using Google Earth, who looked at infrastructure in each area to determine whether it could support services that were claimed by the ISPs. Engineers also conducted field surveys of representative locations in the State.

The project team also tested additional strategies to vet the data, including using databases of Wi-Fi traffic and other internet traffic; it was determined that these approaches were less useful than the manual desk and field surveys.

Collectively, the ADECA project team's vetting mechanisms all demonstrated the accuracy of ISP-provided data to be in the mid to high 90 percent range—giving ADECA significant confidence that the data are accurate.

Continuing its collaborative approach, ADECA shared the preliminary results with the ISPs for input and feedback, subject to the NDAs. A formal challenge process will be available to the ISPs early in 2022 as a means of further clarifying and improving The Alabama Broadband Map.

2.3 ABC for Students

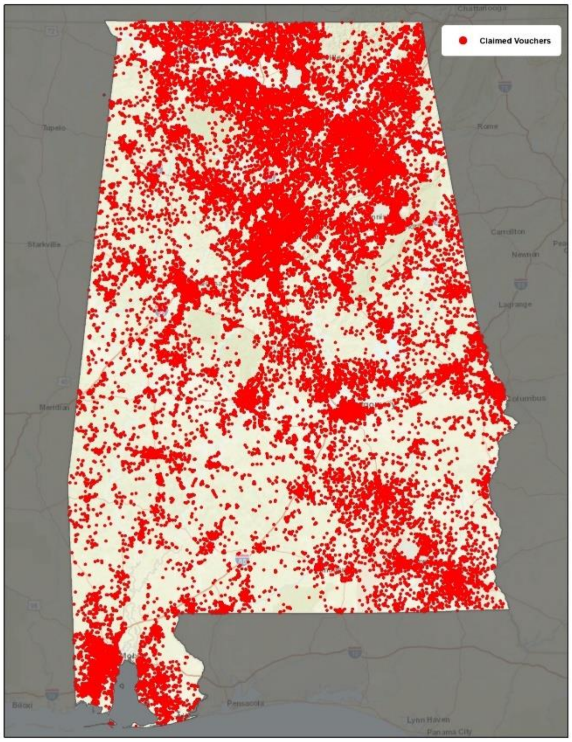
Alabama Broadband Connectivity (ABC) for Students was a first-of-its-kind program with a remarkable set of outcomes. Significant elements of the program's structure have been replicated in other states, including Georgia, Delaware, and New Mexico.

Figure 5: ABC for Students website

ABC for Students was a $50 million statewide initiative through which the State provided free internet access to more than 200,000 low-income students (Figure 6, below).

Enabled by an allocation of federal CARES Act funding, the ABC for Students program was a public-private partnership launched in a matter of weeks over the summer of 2020 as it became clear that Alabama schools would use distance learning for at least some of this school year. The State used its data on participation in the National School Lunch Program to identify families that would be eligible for the free broadband service.

Figure 6: ABC for Students participant locations



ADECA mailed personalized voucher codes to every eligible family in Alabama—empowering residents to sign up for service, while also seeking to minimize administrative burdens on local schools. Behind the scenes, ADECA identified and signed contracts with nearly four dozen ISPs that committed to serving eligible families in rural and urban communities. The ISPs—most of which were small Alabama companies—were reimbursed by the State for providing equipment, installation, and ongoing service.

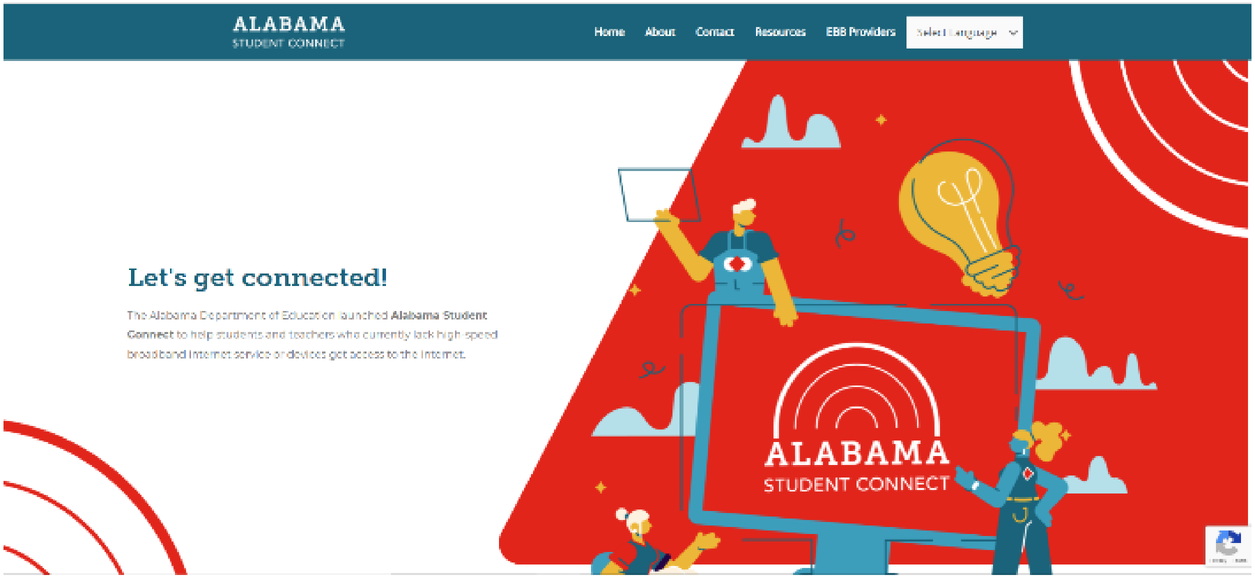
ABC for Students provided funding for the entire 2020–2021 school year. As the subsidy funding came to an end in June 2021, the program's call center remained open through August and actively helped families transition from the ABC for Students program to the FCC's new Emergency Broadband Benefit (EBB) program, which offered a similar monthly subsidy for broadband service.

The ABC for Students call center Ambassadors worked with ISPs and families to enable as smooth a transition as possible from the State's program to the federal program—and to ensure that Alabama's families continued to receive service. The Ambassadors helped more than 2,000 families enroll in the EBB program. (Over the course of the ABC for Students program, the Ambassadors fielded more than 55,000 calls from participants and ISPs.)

ADECA's pioneering ABC for Students initiative has since been picked up by the Alabama State Department of Education (ALSDE), which recognized the imperative to support its low-income students. As the ABC for Students program ended at the end of August 2021, ALSDE created a program to continue that work, called Alabama Student Connect (Figure 7, below).[7]

[7] "Alabama Student Connect," https://alstudentconnect.org/.

Figure 7: ALSDE's Alabama Student Connect Program website



The program team has called 56,406 families over the past few months and helped more than 11,000 of them get signed up for the EBB program. That federal subsidy program is transitioning in 2022 to the new Affordable Connectivity Program (ACP)—so the Alabama Student Connect program is now well-positioned to help low-income students' families transition from the EBB program to the ACP.

While the ACP funding amount is lower than the EBB program's monthly subsidy, the eligibility requirements for ACP are much broader (i.e., families can have income up to 200 percent of the federal poverty line rather than 130 percent)—so there is potential for ACP to benefit many more Alabama households.

3 Current data regarding broadband infrastructure and adoption in Alabama

The following sections describe the State's current broadband availability data and status, based on The Alabama Broadband Map, surveys, and other data.

3.1 Approximately 19 percent of Alabama addresses cannot access service that meets the emerging definition for broadband

The Alabama Broadband Map indicates that roughly 13 percent of Alabama's 1.65 million addresses are unserved by broadband of at least 25/3 (the FCC's current benchmark speed), while about 19 percent of addresses are unserved by 100/20 service—the threshold recommended as the State's five-year target to align with new federal funding opportunities (see Section 3.1). Higher-speed services like 100/100 and symmetrical 1 Gbps are available only to about 25 percent of addresses (Table 2).

Table 2: Current status of broadband coverage in Alabama[8]

	25/3	100/20	100/100	1000/1000
Number of unserved addresses (out of total of 1,649,535)	210,302	310,874	1,237,122	1,262,945
Percentage of total addresses that are unserved	12.7%	18.8%	74.99%	75.56%

By compiling granular data about broadband availability, ADECA has gained a deeper understanding of what areas are unserved, while simultaneously ensuring that it can maximize potential federal funding that might otherwise be inaccessible because of FCC data that incorrectly identifies an area as being served.

The Alabama Broadband Map currently identifies approximately 210,000 addresses unserved by 25/3 broadband (Figure 8), while the FCC's map indicates only about 84,000 unserved addresses (Figure 9). Overlaying the maps illustrates the areas shown as unserved on The Alabama Broadband Map but as served on the FCC's map; those areas are shaded in blue in Figure 10.

[8] Source: Alabama Broadband Map, https://adecagis.alabama.gov/broadband2021/.

Figure 8: Alabama Broadband Map – addresses unserved by 25/3

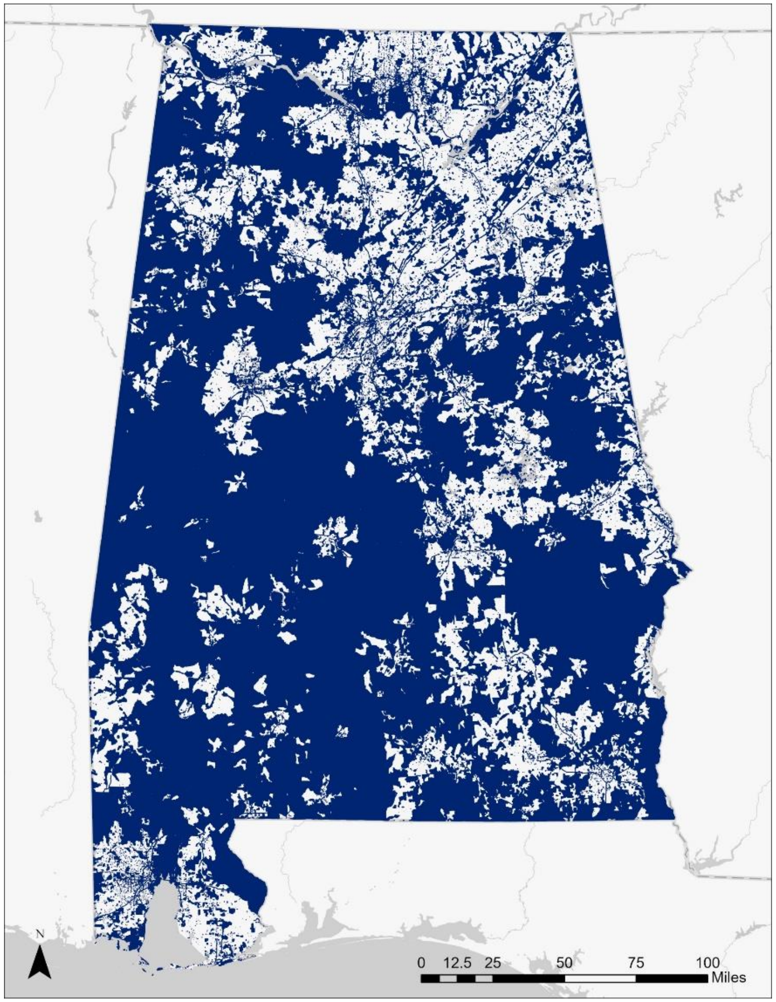
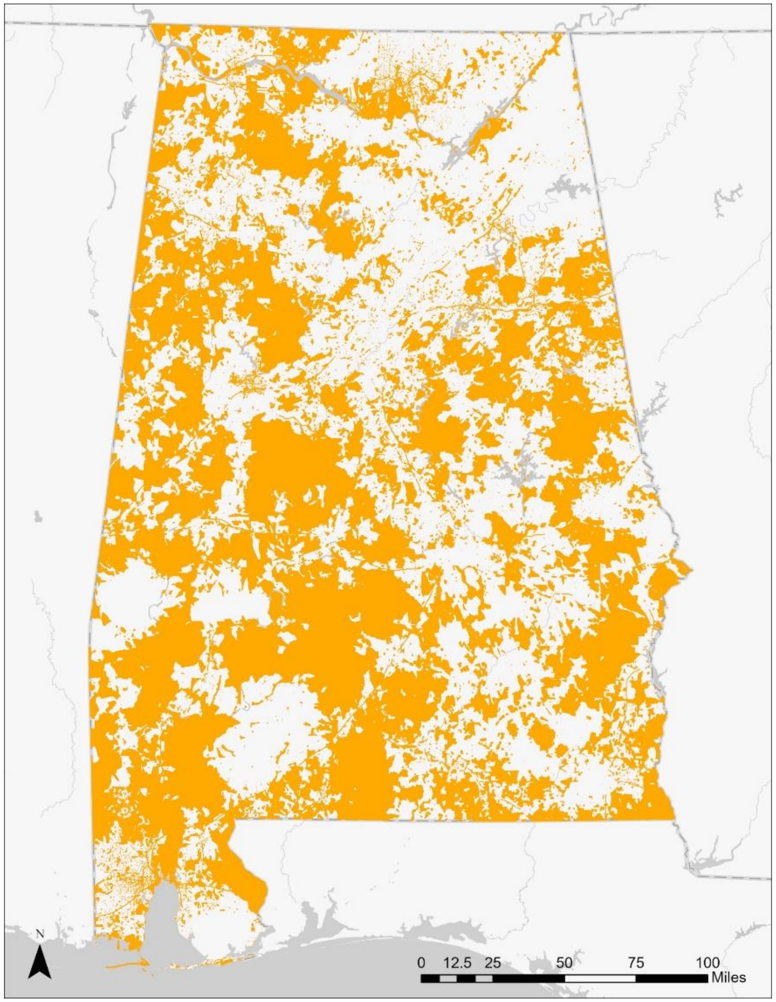
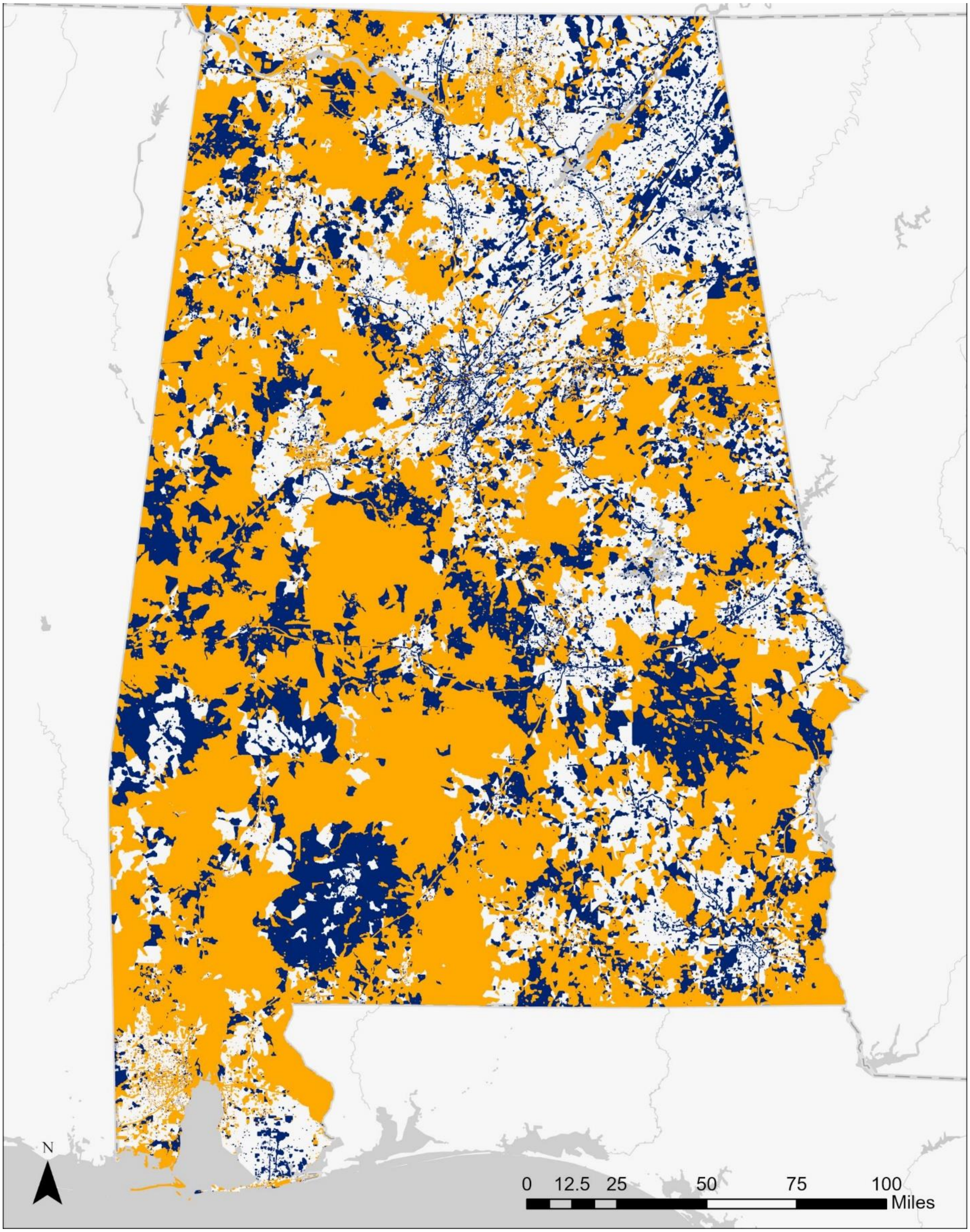


Figure 9: FCC broadband map – unserved addresses[9]



[9] Source: "Fixed Broadband Deployment, Federal Communications Commission, map, https://broadbandmap.fcc.gov/#/about.

Figure 10: Comparison of Alabama and FCC broadband maps



Analysis of current Alabama Broadband Map data finds that census blocks across the State range from completely served to completely unserved at broadband speeds of 25/3 up to symmetrical gigabit. The maps below share the following key:

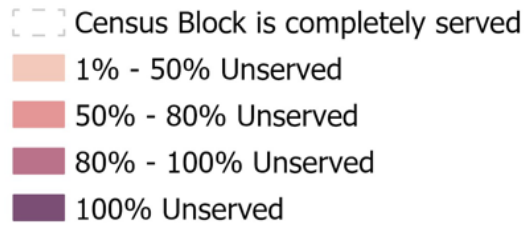
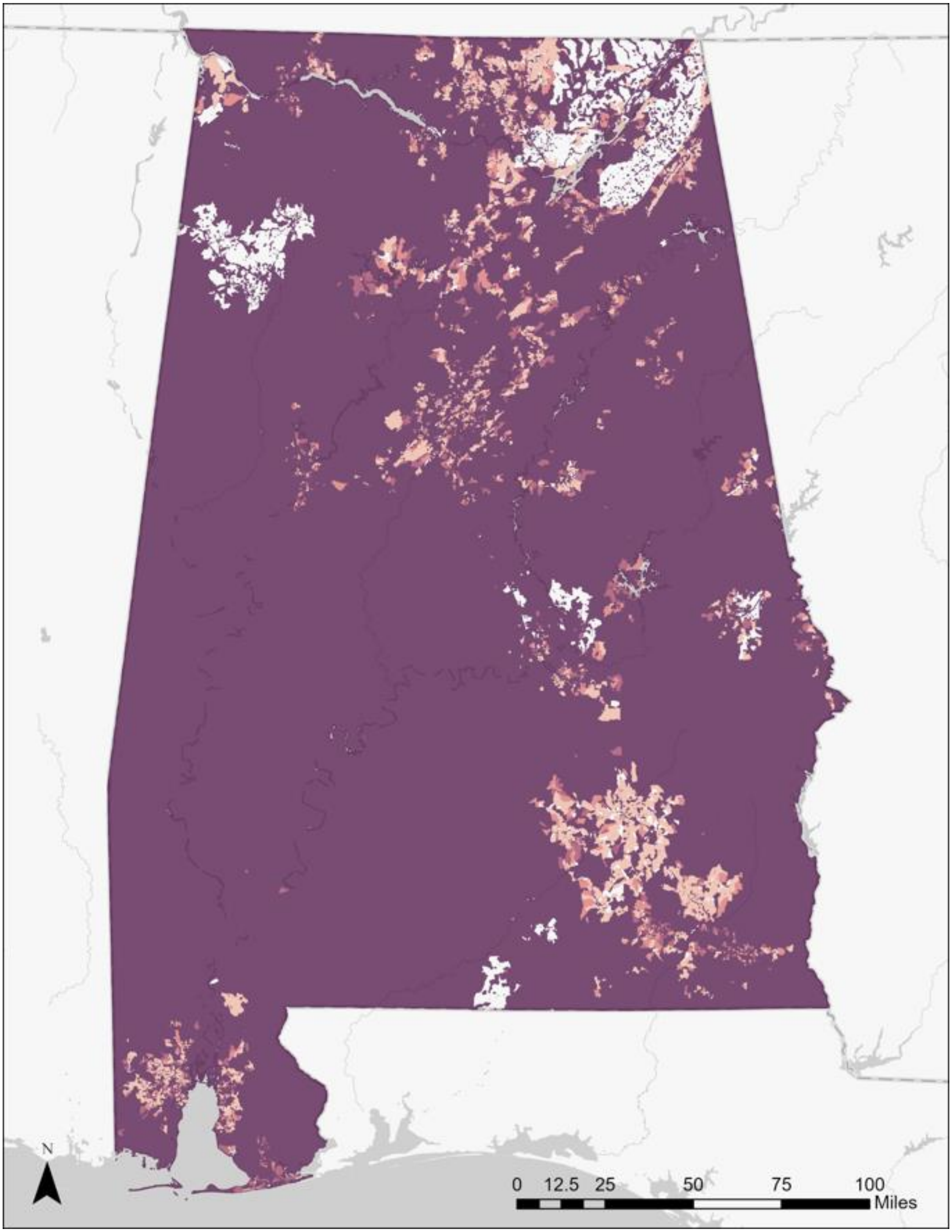


Figure 11: Alabama Broadband Map – unserved by 25/3

Figure 12: Alabama Broadband Map – unserved by 100/20

Figure 13: Alabama Broadband Map – unserved by 100/100

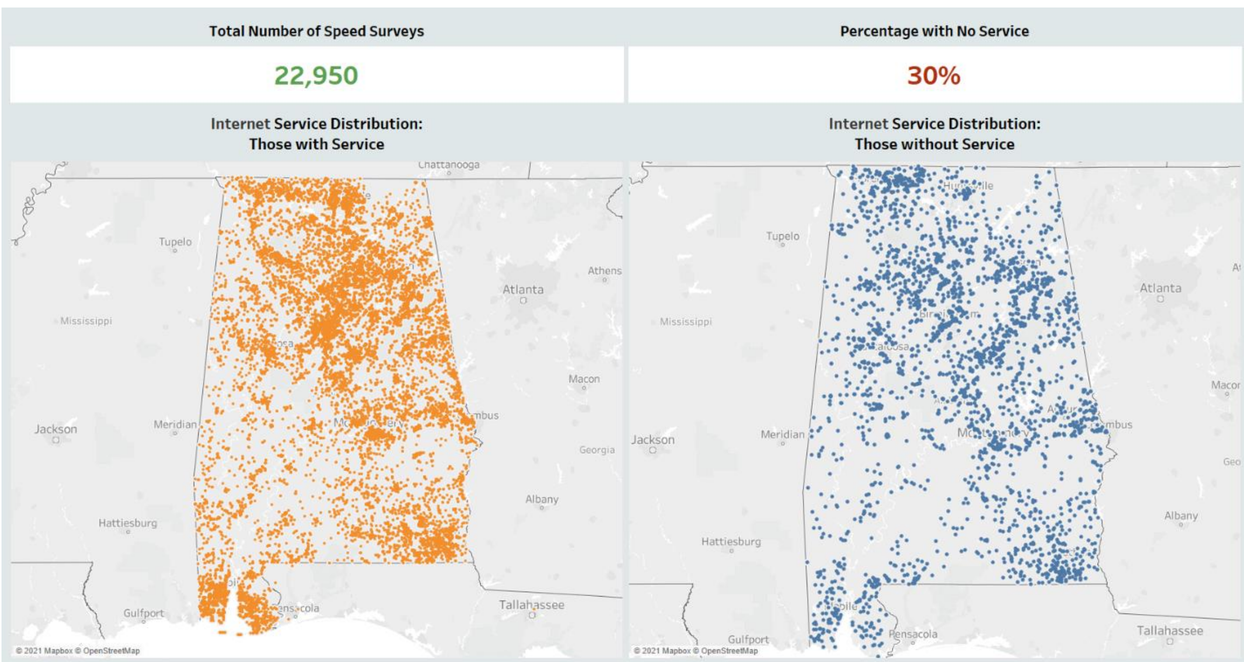
Figure 14: Alabama Broadband Map – unserved by 1 Gbps/1 Gbps



The results of 16,000 speed tests collected by ADECA highlight the disparities in performance between different types of broadband technology, in particular the far faster speeds offered over cable broadband and fiber, as compared to the far slower speeds delivered via satellite and DSL. The test site also enables identification of the locations where service is lacking, given that about 60 percent of respondents' tests demonstrate service below the 25/3 threshold and 78 percent of respondents' tests demonstrate service below the 100/20 level recommended as the State's five-year target broadband threshold (Figure 16, below).[10]

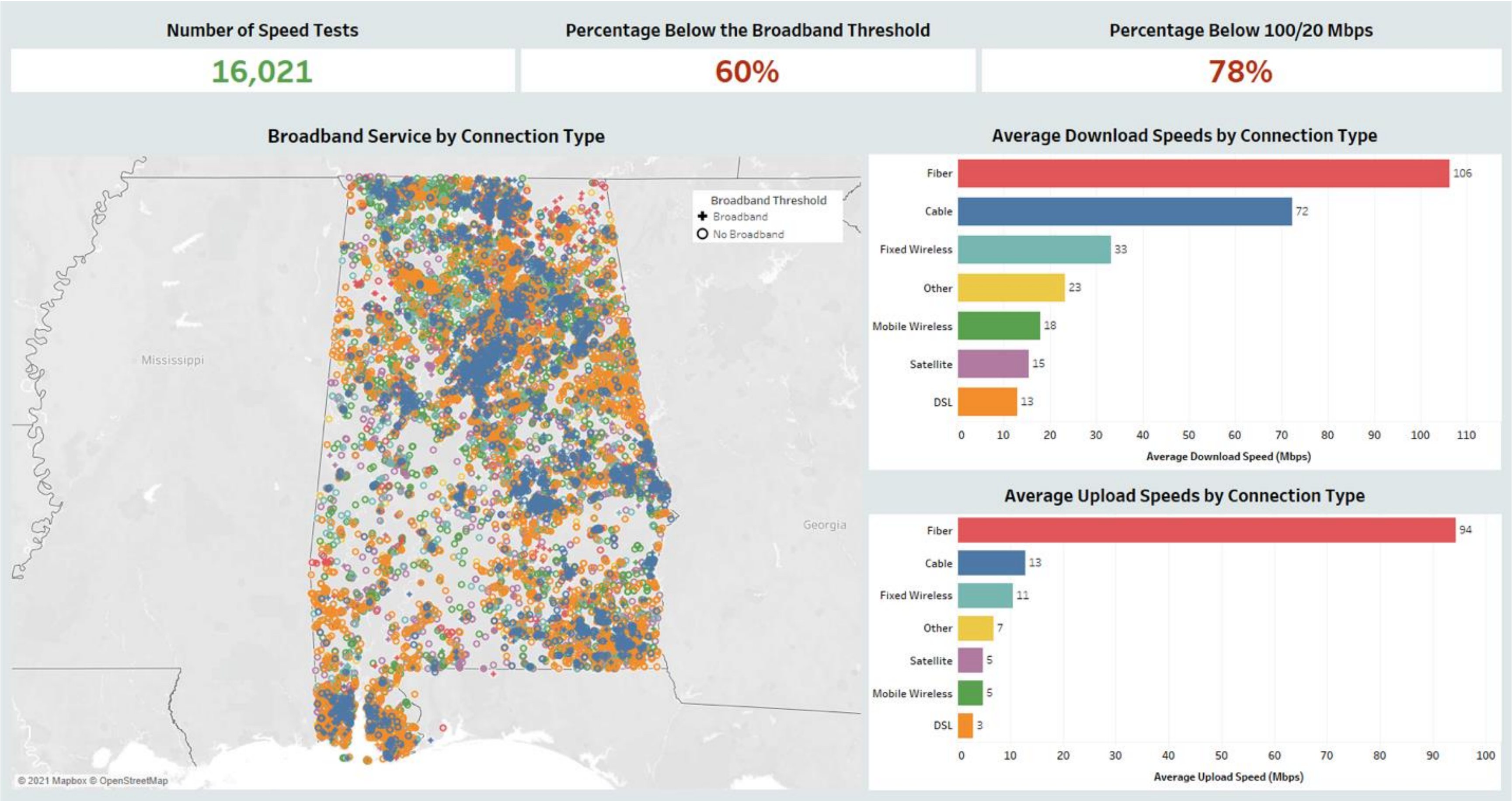
As of the writing of this plan, ADECA had received approximately 22,950 surveys—with roughly 16,000 respondents performing speed tests of their services and about 30 percent of respondents indicating that they have no service at their address (Figure 15).

Figure 15: Survey results indicating unserved locations



[10] The ADECA online speed survey website measures respondents' actual service speeds—and captures information from households who report that they do not have service available at their address. The survey is available in English and Spanish.

Figure 16: Speeds recorded by survey respondents with service



3.1.1 Alabama's broadband infrastructure and services lag most states in the region

To understand how Alabama's broadband environment compares with neighboring states, this section offers a comparative analysis of FCC data (FCC data is inherently problematic but is used here in order to enable like-to-like comparisons). The comparative analysis illustrates that Alabama lags many other states in the region with regard to 25/3 and 100/20 service (Table 3).

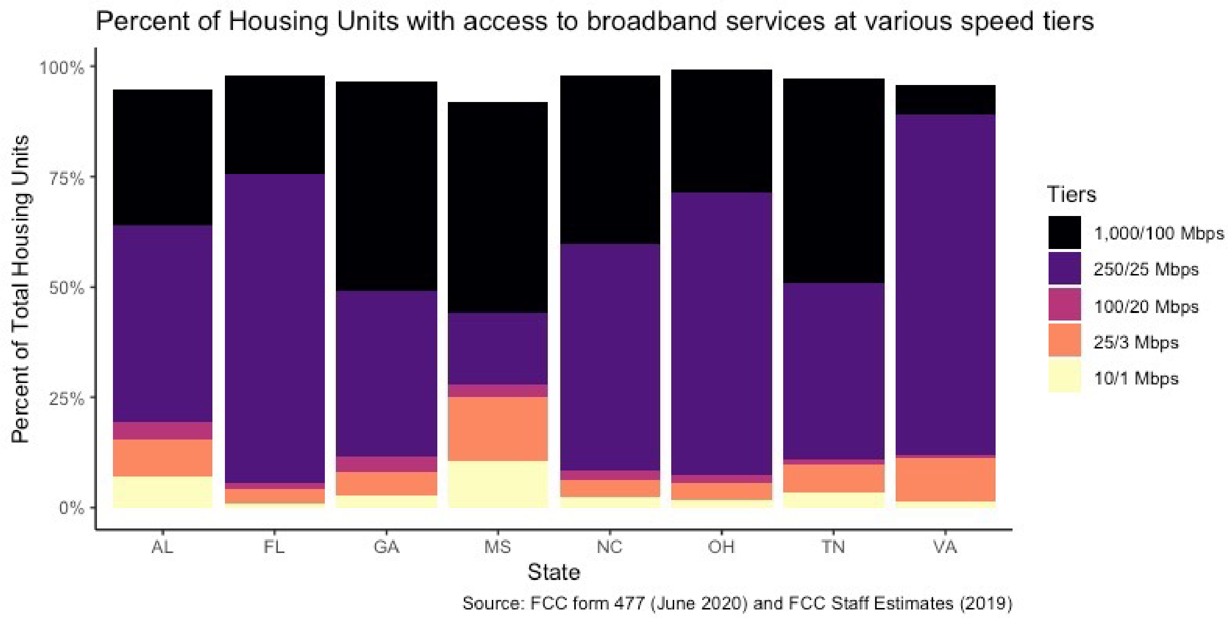
Table 3: Comparison by state – access to 25/3 and 100/20 service[11]

	AL	FL	GA	MS	NC	OH	TN	VA
25/3	87.7%	97.1%	93.8%	81.6%	95.6%	97.8%	94.0%	94.2%
Cable/Fiber	82.4%	94.4%	89.3%	75.3%	93.1%	94.3%	90.6%	89.8%
DSL	45.4%	49.8%	60.6%	38.9%	51.9%	50.8%	54.7%	5.5%
Wireless	4.9%	28.2%	1.8%	17.9%	4.9%	24.7%	7.7%	24.6%
Other	5.3%	2.7%	4.4%	6.3%	2.5%	3.5%	3.5%	4.5%
100/20	79.1%	94.0%	88.5%	66.9%	91.7%	93.9%	87.5%	84.5%
Cable/Fiber	77.6%	93.2%	85.5%	64.9%	91.2%	93.5%	87.0%	84.3%
DSL	18.9%	27.6%	39.7%	19.5%	20.4%	23.0%	24.1%	0.1%
Wireless	0.0%	2.0%	1.2%	0.0%	1.5%	0.3%	0.2%	2.6%
Other	1.5%	0.8%	3.1%	1.9%	0.6%	0.4%	0.5%	0.2%

The following chart presents a visual interpretation of those data, as well as higher-download-speed broadband services available to addresses in the same states (Figure 17, below).

[11] Source: FCC Form 477.

Figure 17: Speeds accessible by households in Alabama and other states[12]



These data indicate that fiber and cable are the clear leaders in delivering 100/20 Mbps service. While DSL and wireless may be able to deliver minimum 25/3 broadband speeds, those technologies are not delivering nearly as much broadband at 100/20 Mbps.

3.1.2 The cost to bridge the State's infrastructure challenge is likely to range from $4 to $6 billion

An engineering estimate of the effort needed to bridge Alabama's rural broadband infrastructure gap finds that deploying 100/100 service to all addresses currently unserved by 100/20 would cost between $4 billion and $6 billion as a best-case, baseline estimate. That cost estimate assumes:

- Deploying infrastructure capable of 100/100 throughout unserved areas
- Constructing line extension from existing networks to unserved pockets within otherwise-served areas
- Constructing long-haul and middle-mile facilities where necessary to connect new infrastructure to the internet backbone (a requirement that is addressed with a percentage increase to the estimated cost of last-mile infrastructure)

[12] Source: FCC Form 477 and FCC staff estimate.

The cost estimate also makes conservative assumptions about cost increases associated with the current supply challenges in broadband construction materials and labor. The detailed engineering analysis is included in Appendix B.

An economic impact analysis suggests that this investment would deliver a wide range of impacts to Alabama (see Appendix D).

3.2 Adoption and use

Even where broadband infrastructure and services are available, they may not be attainable by all members of the community. A complex combination of factors—including affordability, device access, digital skills, and language barriers—can inhibit use of the broadband internet, to the detriment of both economic and community development.

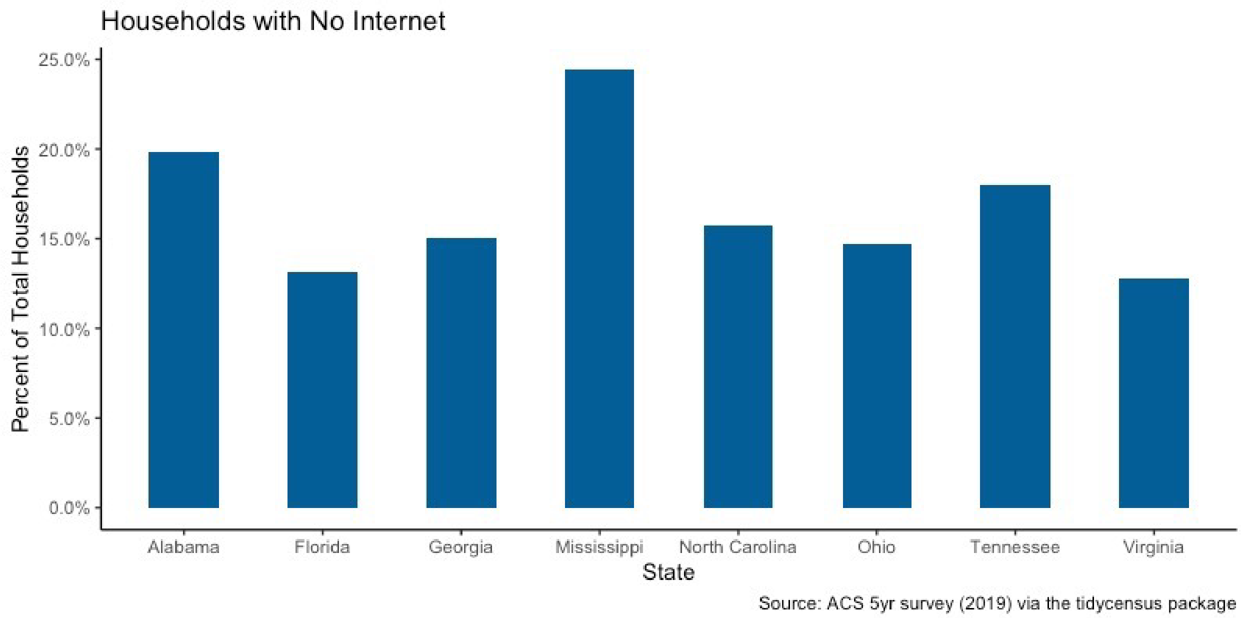
Given these challenges, ADECA has undertaken research and analysis to understand the challenges faced, particularly by lower-income Alabamians, in using broadband.[13] This section of the plan summarizes a range of types of data developed and analyzed by ADECA as a means of understanding the larger challenges—and the opportunities potentially presented to increase broadband adoption and use.

In brief, there exists considerable opportunity to increase use of broadband among Alabama households. Approximately 20 percent of households do not currently subscribe to broadband services, among the highest numbers in the region.

Figure 18 (below) compares the percentage of households without internet in states throughout the region.

[13] In November 2021, ADECA's project team surveyed low-income households in all geographic regions of Alabama to help assess the use of broadband and enrollment in internet subsidy programs among low-income households. The survey was designed to gather feedback and insights on use of internet services, plus awareness and use of subsidy programs, by low-income households. The results of the survey, along with data from the U.S. Census Bureau and other sources, document Alabama residents' current adoption and use of internet services and low-income subsidy programs. That research is summarized in this section of the plan, with full survey results included in Appendix C.

Figure 18: Households with no internet subscriptions



3.2.1 Affordability represents a significant challenge to broadband use

Interest in internet service is high, as 88 percent of low-income households surveyed by ADECA have some form of service, including home internet or mobile connections. However, the leading barrier to service is cost. Two-thirds of the low-income survey respondents who do not have internet service cite cost as the key challenge and 56 percent of those who do have service report that they have cut spending on other essential expenses over the last year to pay for internet service (Figure 19, below). Specifically, more than four in 10 internet subscribers have cut spending on food items to pay for internet service, while 39 percent have cut entertainment and recreation expenses and 36 percent have cut spending on clothing, footwear, or personal care items (see Figure 20).

Figure 19: Cut spending to pay for internet service

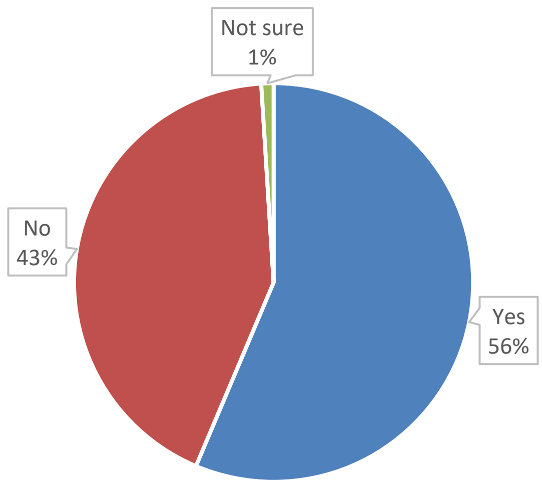


Figure 20: Expenses cut to pay for internet service

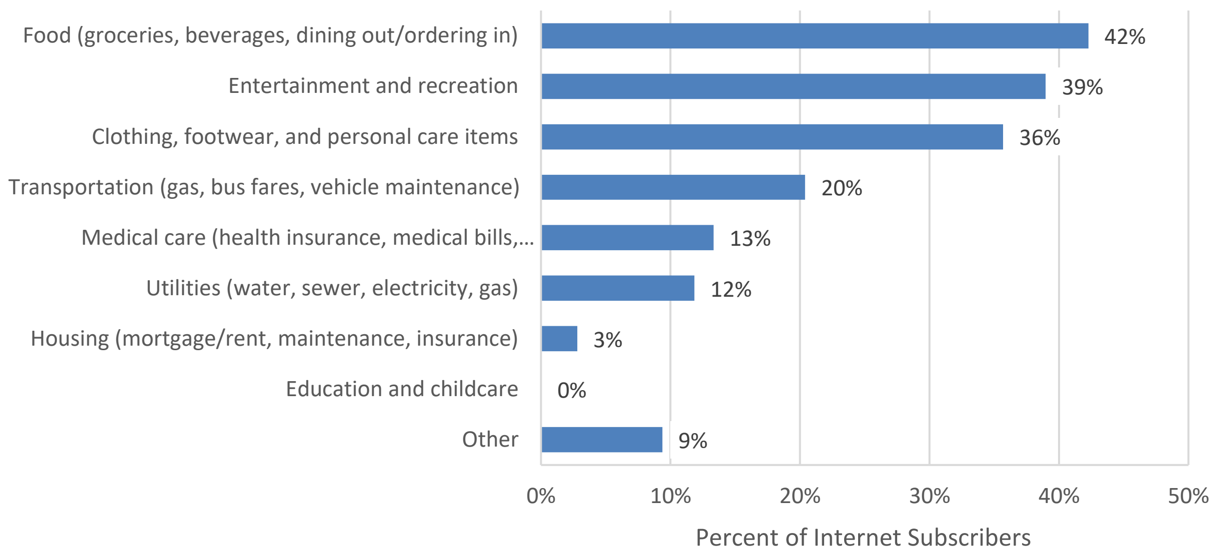


Figure 21 illustrates data from the American Community Survey (5YR 2019, Table B28002, "Presence and Types of Internet Subscriptions in Household").

Figure 21: Households with internet subscriptions (American Community Survey data)

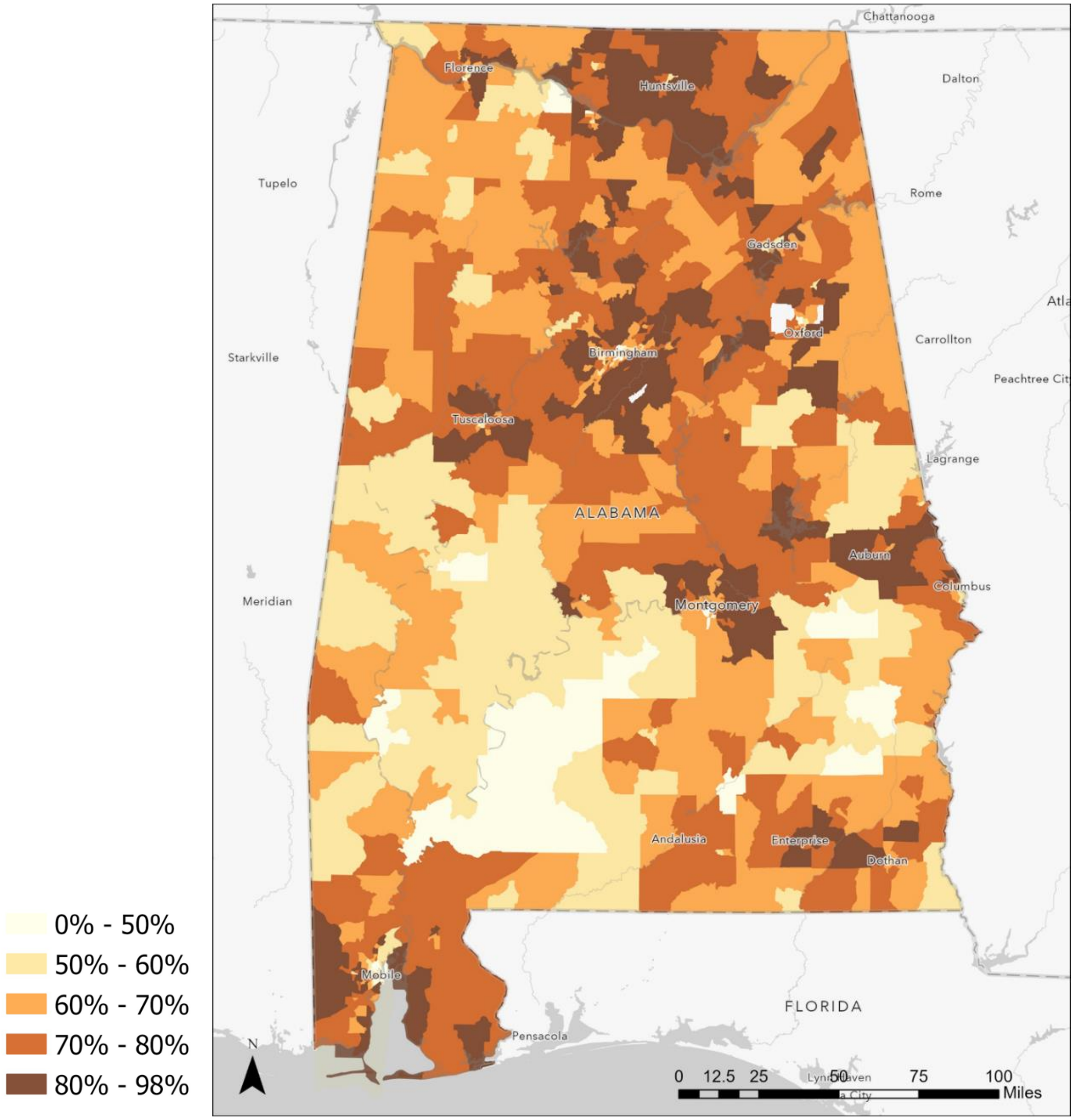
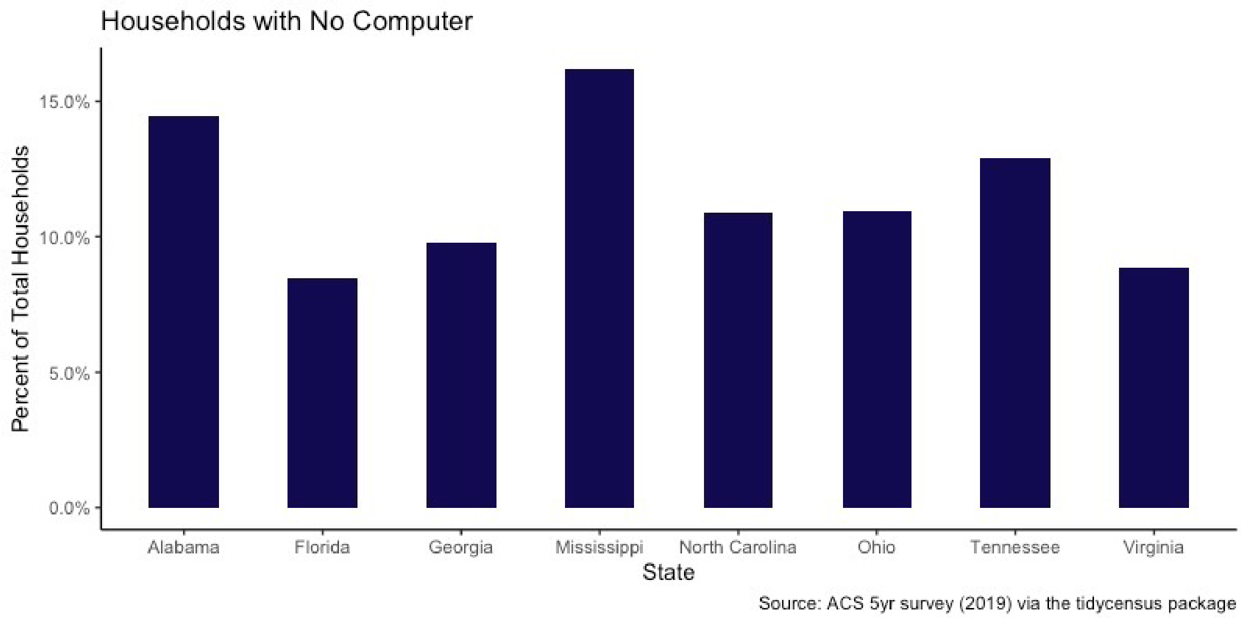


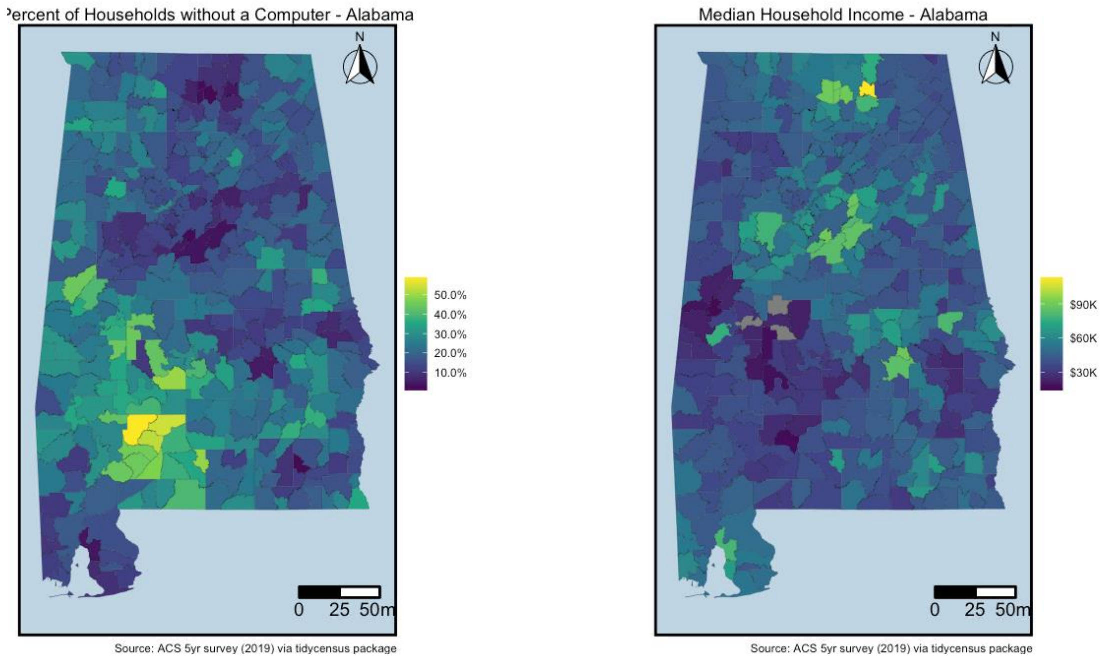
Figure 22 compares the percentage of households without a computer at home:

Figure 22: Households with no computer (American Community Survey data)



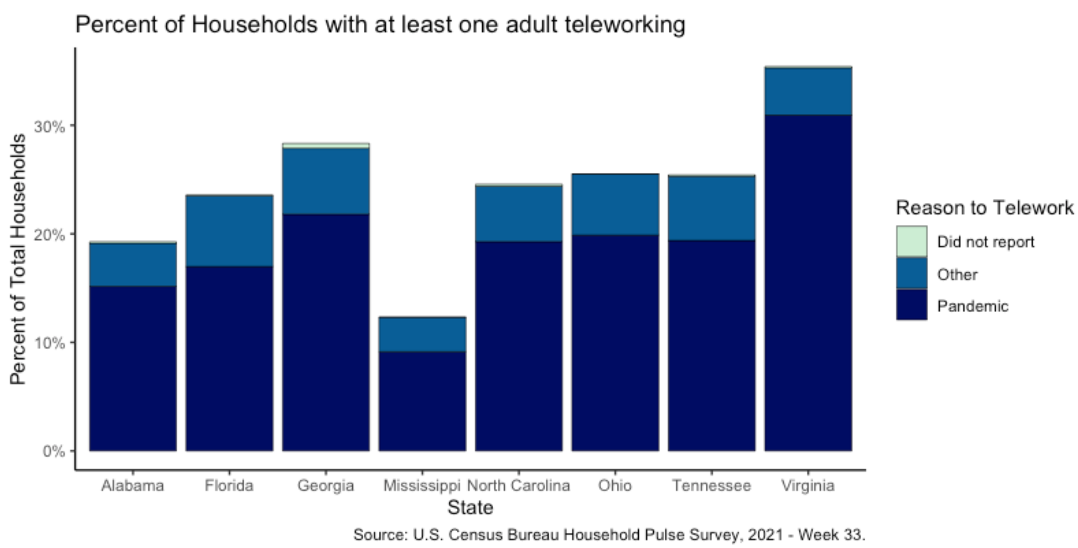
Alabama has the second-highest total percentage of homes without computers among the states compared. A household's lack of a computer frequently correlates with income, as shown in these maps which compare median household income with the percentage of households without a computer (Figure 23).

Figure 23: Lack of computer frequently correlates with income



Compared to these other states, Alabama also has one of the lowest percentage of households with at least one adult teleworking, as shown in Figure 24.

Figure 24: Households with at least one adult teleworking



3.2.2 Participation in low-income subsidy programs is relatively strong in Alabama, with opportunity to increase use by eligible households

The data suggest that Alabama is already making strides toward increasing broadband use among low-income residents who cannot afford to purchase it.

Alabama ranks high among peer states for its residents' use of the FCC's Emergency Broadband Benefit program (but not the Lifeline program) (Table 4, below), likely as a result of the State's leading efforts to engage eligible families through the ABC for Students and Alabama Student Connect programs. The total number of enrolled households varies across the State (Figure 25 by census block, Figure 26 by county).

Figure 25: Emergency Broadband Benefit enrollment by census block in Alabama

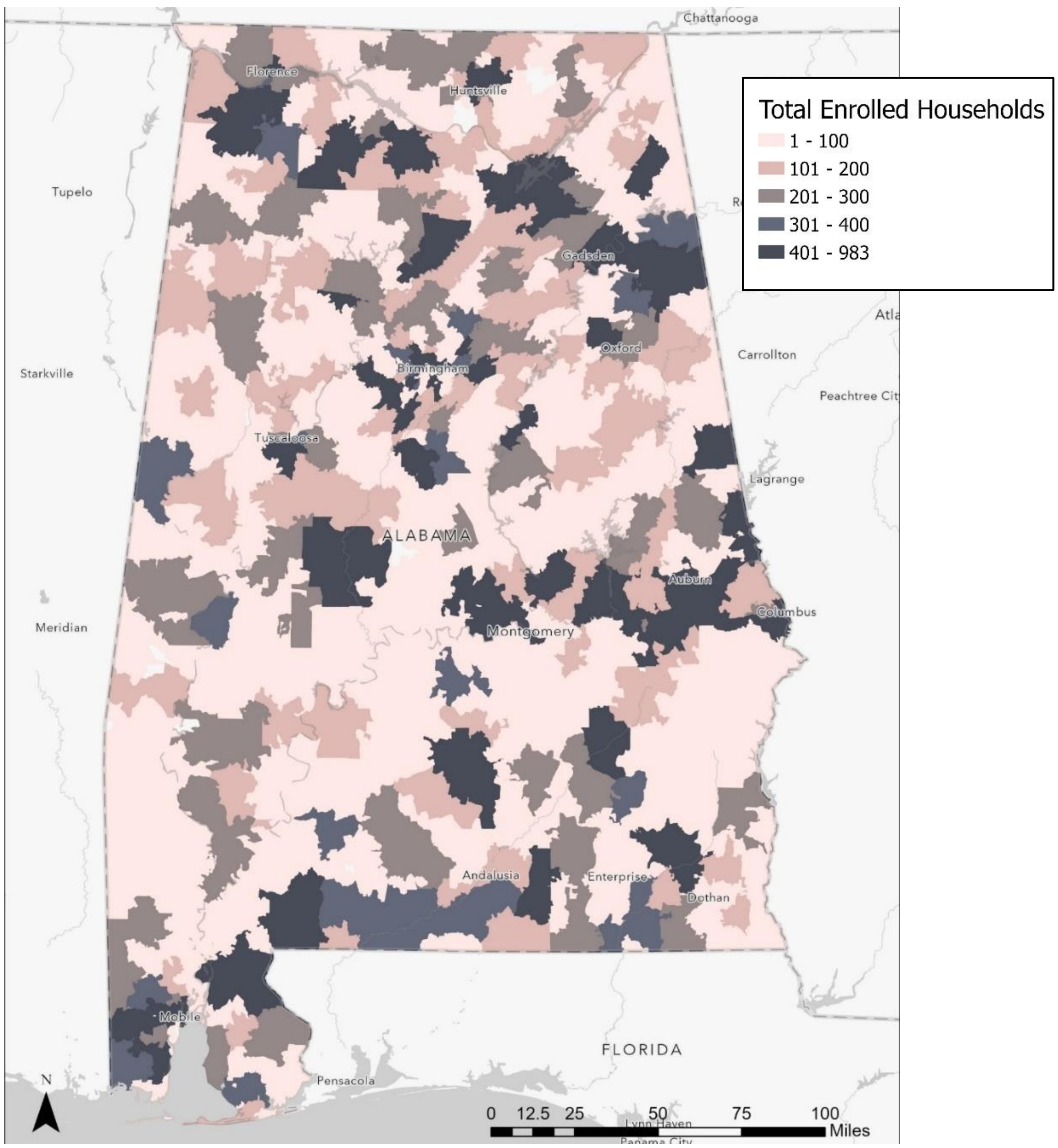


Figure 26: Emergency Broadband Benefit enrollment by county in Alabama

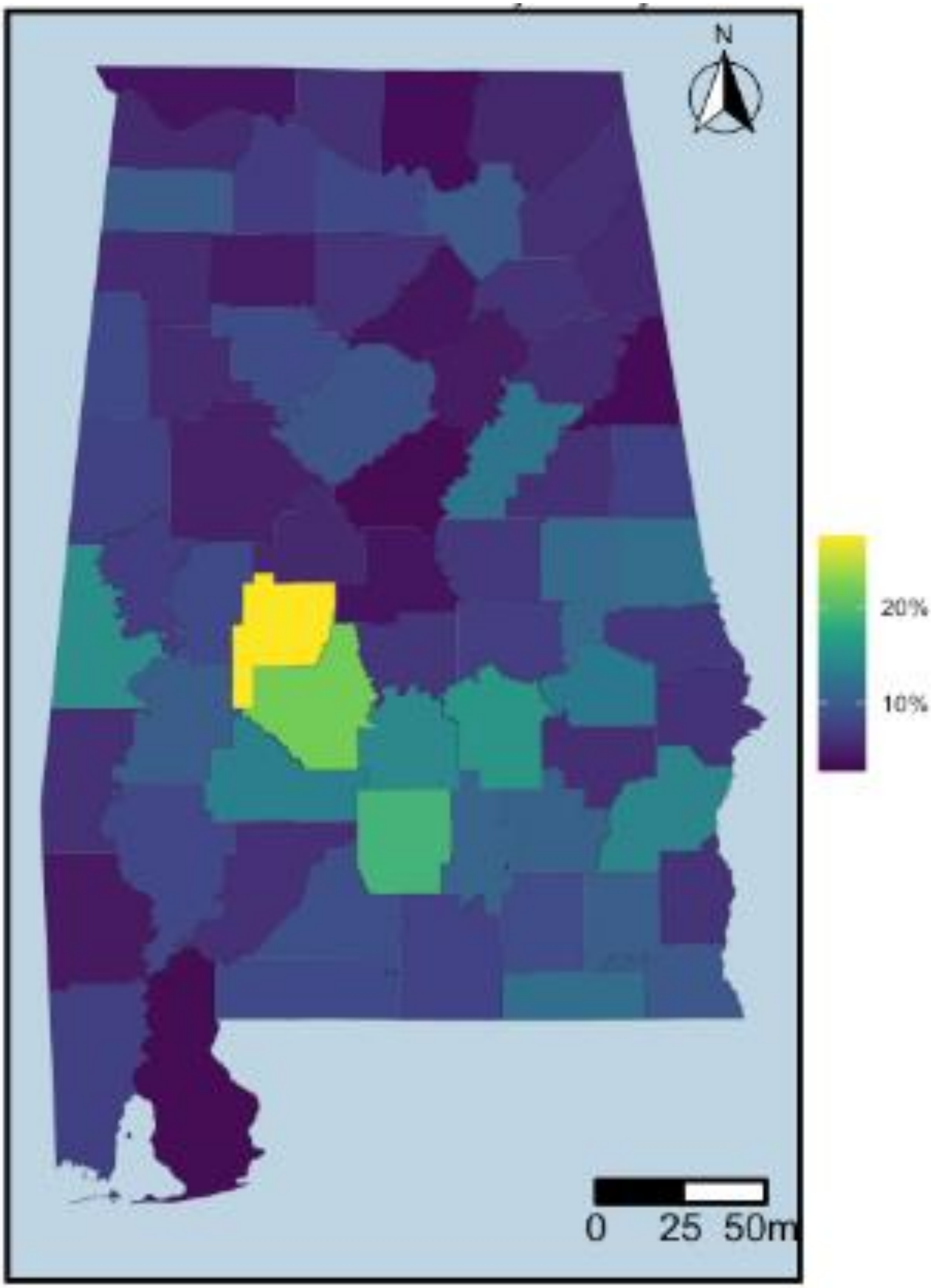


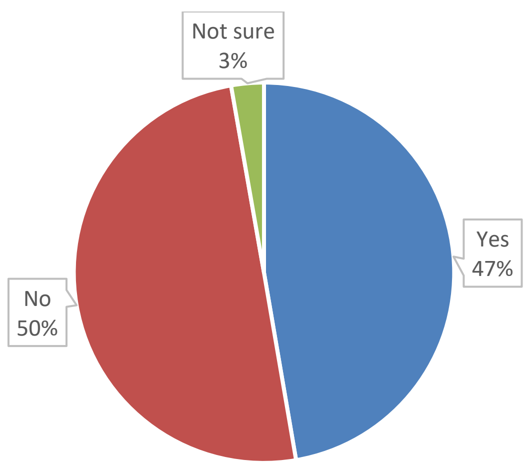
Table 4: Use of low-income subsidy programs by state

State	Total household EBB participation	October 2021 Lifeline participation	Total households 2019	2019 Lifeline eligible households	Households subscribed to EBB	Households eligible for Lifeline that are subscribed to EBB	Estimated 2021 Lifeline participation rate of eligible households
Alabama	**156,010**	**76,465**	**1,867,893**	**578,459**	**8.4%**	**27%**	**13%**
Florida	546,330	339,777	7,736,311	2,149,002	7.1%	25%	16%
Georgia	285,619	215,896	3,758,798	1,041,073	7.6%	27%	21%
Mississippi	101,971	77,088	1,104,394	387,431	9.2%	26%	20%
North Carolina	303,803	145,051	3,965,482	1,095,902	7.7%	28%	13%
Ohio	441,615	272,882	4,676,358	1,265,486	9.4%	35%	22%
Tennessee	166,902	112,444	2,597,292	739,002	6.4%	23%	15%
Virginia	144,480	103,539	3,151,045	639,449	4.6%	23%	16%

Even as the State's participation in the Emergency Broadband Benefit is robust, there is opportunity to increase participation. Only half of the survey respondents indicated that they have heard of broadband internet subsidy programs, and only 35 percent know of the Emergency Broadband Benefit program.

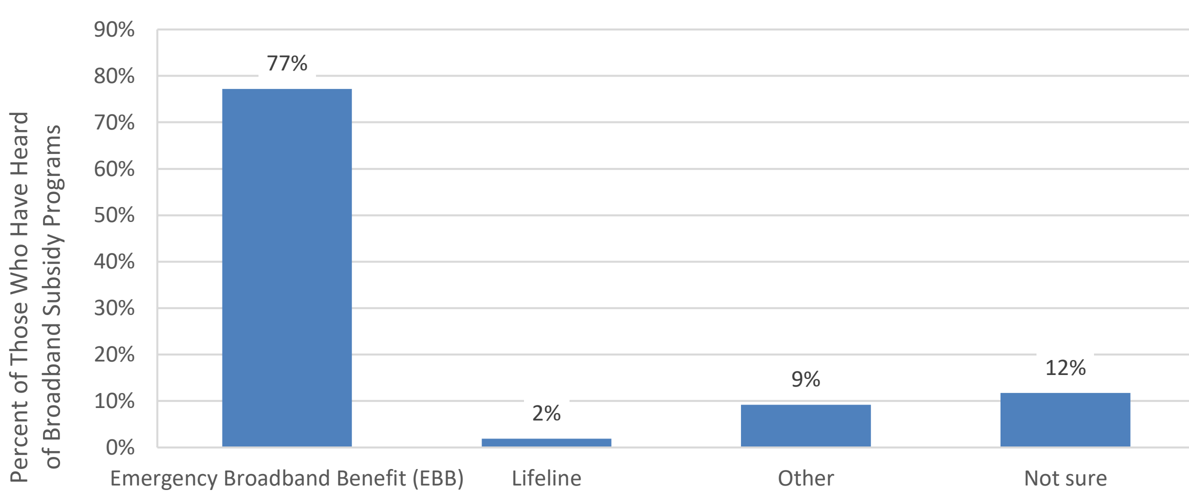
Nearly one-half (47 percent) of respondents have heard of broadband internet subsidy programs, while one-half were not aware of these programs (see Figure 27). As may expected, awareness was higher among those with internet than those without internet service (50 percent vs. 22 percent).

Figure 27: Heard of broadband internet subsidy programs



More than three-fourths (77 percent) of those aware of broadband internet subsidy programs (or 35 percent of all respondents) have heard of the Emergency Broadband Benefit program (Figure 28). Awareness of other subsidy programs is low.

Figure 28: Broadband internet subsidy programs have heard of



3.3 Federal funding opportunity

Altogether, Congress has appropriated more than $75 billion to subsidize broadband deployment nationwide. Most of that funding is being routed through state governments. This funding is coming through these primary channels, with rules expected to be released in early 2022.

3.3.1 The State will receive broadband funding through ARPA and IIJA programs

Under the American Rescue Plan Act (ARPA), *Fiscal Recovery Fund* money can be used for broadband. *Capital Projects Fund* money must be used for broadband or supporting facilities; $191 million is earmarked for Alabama and likely to be disbursed in 2022.

Under the Infrastructure Investment and Jobs Act (IIJA), *Broadband Equity, Access & Deployment Program (BEAD)* money is for broadband deployment in rural and low-income areas. A minimum of $100 million is earmarked for Alabama, likely to be disbursed in early 2022. More funding will be available based on the State's share of unserved and high-cost addresses in the FCC's forthcoming maps and on the State's five-year plan; while those numbers are very speculative pending the release of the FCC's new maps, Alabama could potentially receive $400 million to $600 million in additional funding—and potentially more.

Also under the IIJA, *State Digital Equity Planning Grant* money is to develop a Digital Equity Plan; a total of $60 million will be distributed among all states and territories in early 2022. *State Digital Equity Capacity Grant* money will be distributed for states to execute their Digital Equity Plans; a total of $1.44 billion will be distributed among all states and territories allocated based on population, poverty, and adoption data over the next five years.

ADECA will need to monitor the IIJA's State Digital Equity Capacity Grant Program requirements in early 2022. States must submit requests for planning grants within 60 days after the program has been established. Other key dates related to funding include the following:

- May 2022 – State and Local Fiscal Recovery Fund (ARPA): Earliest date that the Treasury will distribute the second tranche of funding, containing the remaining 50 percent of funds allocated to each eligible state, locality, and other eligible entity.
- May 14, 2022 (or earlier) – IIJA: The BEAD program and the Enabling Middle Mile Broadband Infrastructure program are to be established. The establishment of the BEAD program should then trigger the allocation of $100 million to Alabama to be used according to the program's criteria.
- September 24, 2022 – Capital Projects Fund (ARPA): Deadline to submit the Grant Plan (Grant Plan Example) and all Program Plans (Broadband Infrastructure Program Plan template; Digital Connectivity Technology Program Plan template; Multi-Purpose Community Facility Program Plan template; Case-by-Case Review Program Plan template)

- December 31, 2026 – Capital Projects Fund (ARPA): Projects must be "substantially complete" and funds must be expended by this date.

There is still considerable uncertainty about the IIJA funding dates and the associated planning documents that the State will need to submit to the federal government. In addition, there are questions about how much funding the State will get. Ideally all of that information will be in hand in order for the State's policy-makers to make the best-informed decisions.

That said, we recommend ADECA develop a detailed implementation plan during the first quarter of 2022 that lays out the full range of tasks necessary, as well as a potential annual budget for the various grant programs that would seek to maximize federal funding.

Creating this implementation plan will then allow ADECA to effectively develop a spend plan and recommendations regarding how much funding might be necessary from the State of Alabama. By way of reference, the following is an analysis of what neighboring states have done with regard to their ARPA funds.

3.3.2 Neighboring states have devoted ARPA Fiscal Recovery funds to a range of broadband efforts

This section summarizes our research into how many dollars, if any, were allocated to broadband from the ARPA Coronavirus State Fiscal Recovery Fund (CSFRF) in the following states: Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee.

In brief, we found the following:

1. Tennessee has announced a strategy of allocating $500 million to broadband programs.
2. Georgia has allocated at least $300 million to its broadband grant program but received grant applications for many times that amount and is thus likely to shortly announce more funds to be added to the grant program.
3. North Carolina has allocated an undecided sum that is likely in the range of $350 to $700 million, based on a complex appropriations bill and vague filings with the Treasury.
4. Florida has chosen not to allocate any money to broadband.
5. Mississippi and South Carolina have not allocated their CSFRF funds yet for any purpose.

States do not have to obligate the CSFRF dollars until Dec. 31, 2024, and there may therefore be additional activity in the states neighboring Alabama. According to the Pew Charitable Trusts, as of November 2021, approximately half the states have appropriated ARPA funds for broadband uses.[14]

The following is a more detailed discussion of each state's allocations of CSFRF, if any.

Florida: *No funding allocated to broadband projects*

The state report to the Treasury included no broadband funds.[15] Florida SB 2500 (appropriations legislation) §152 provides a lengthy list of the state's allocation of the CSFRF3 but does not appear to include broadband.

Georgia: *$300 million for broadband projects has been announced thus far, but the actual allocation may be more*

The initial CSFRF allocation for broadband projects was $300 million from the first tranche of ARPA funds, but the state has suggested intent to shift funding from other programs to support broadband if necessary.[16] The current grant opportunity is vastly oversubscribed (i.e., the state received applications requesting three to four times the amount of funding allocated thus far). Grant awards will be announced in January, so any increased allocation to broadband projects will likely be made public soon.

Mississippi: *None of the first tranche of CSFRF funding has been allocated thus far, for broadband or other programs*

According to the Department of the Treasury, the CSFRF funds "are awaiting appropriations by the 2022 Mississippi Legislative Session per Mississippi House Bill 109. Per HB 109, the funds will remain in a special fund in the State Treasury until such time as appropriated for use in accordance with the American Rescue Plan Act."[17]

It appears that Mississippi is trying to use a major portion of the funding to replace income taxes, which appears to be in violation of the federal program rules and has led to legal challenges.[18]

North Carolina: *The state's specific CSFRF is unclear but $350 to $700 million has been allocated for broadband and may be funded from the CSFRF rather than from other sources*

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[14] "How States Are Using Pandemic Relief Funds to Boost Broadband Access," Pew, December 6, 2021, How States Are Using Pandemic Relief Funds to Boost Broadband Access | The Pew Charitable Trusts (pewtrusts.org).
[15] https://home.treasury.gov/system/files/136/Florida_2021-Recovery-Plan_SLT-2564.pdf
[16] Georgia_2021-Recovery-Plan_SLT-1189.pdf (treasury.gov)
[17] Mississippi_2021 Recovery Plan_SLT-0976.pdf (treasury.gov)
[18] Ibid.; https://mississippitoday.org/2021/11/17/how-other-states-are-spending-federal-stimulus-money/

The state's allocation of CSFRF resources to its broadband program in its Budget Appropriations Bill (628 pages) is unclear.[19] The CSFR funds seems to be mixed in with the normal budget, rather than allocated with more clarity. The legislature has funded the following programs, and it appears that CSFRF funds may be the source for these new appropriations for broadband:

1. Increase of $340 million for the existing Growing Rural Economies with Access to Technology grant program[20]
2. Increase of $400 million for the Completing Access to Broadband program[21]

South Carolina: *CSFRF funds have not been allocated*

As of December 27, the state had not allocated the funds but the legislature is likely to address this matter when session begins in January.[22]

The AccelerateSC task force, which was created to advise the state on its economic recovery, has advised the state to allocate $490 million in federal funding for broadband expansion, potentially from CSFRF funds.[23]

Tennessee: *$500 million potential allocation for broadband access and adoption programs*

State of Tennessee strategy documents suggest an allocation of $500 million for broadband from the first tranche of ARPA CSFRF funds, though it does not appear that there has been legislation to that effect yet.[24]

[19] https://www.ncleg.gov/Sessions/2021/Bills/Senate/PDF/S105v8.pdf.
[20] https://carolinapublicpress.org/45941/nc-house-votes-to-expand-high-speed-broadband-internet-access-across-state/.
[21] https://carolinapublicpress.org/45941/nc-house-votes-to-expand-high-speed-broadband-internet-access-across-state/.
[22] https://www.wrdw.com/2021/12/28/how-south-carolina-may-spend-25b-pandemic-relief-money/.
[23] https://accelerate.sc.gov/sites/default/files/Documents/accelerateSC%20Report.ARPA_.pdf.
[24] https://www.tn.gov/content/dam/tn/finance/documents/financial-stimulus-accountability-group/080421FSAG.pdf, pp. 7, 10. https://www.tennesseebroadband.com/2021/08/tennessee-to-use-500-million-from-american-rescue-plan-for-broadband/.

4 Recommendations

Based on the data and analysis documented above, this plan makes recommendations in five categories:

- Broadband definitions and goals
- Infrastructure and grant programs
- Data and mapping
- State and local collaboration
- Affordability and adoption

4.1 Broadband definitions and goals

Broadband goals should be based on evolving definitions and long-term planning. While the FCC's current minimum standard for broadband is 25/3 Mbps, that definition is universally considered outdates and is likely to change in the near-term.

The emerging definition of broadband is 100/20, which is supported by most ISPs and better aligns with the needs of users in the current time. Congress has effectively redefined broadband at this level through appropriations—by making funding available for areas that lack 100/20.

Increasingly, though, publicly funded infrastructure is required to be capable of 100/100 service, which effectively future-proofs public investments. The definition, which is recommended for new networks being planned now, recognizes the need to build sufficient infrastructure just once—and the risk that public funding of lesser infrastructure could require additional funding for upgrades a few years from now.

Goal-setting is complicated by uncertainty around the total federal funding that will be available to the State as well as current market conditions that are impacting supply chain and labor availability. With the understanding that the State's overall goal is to ensure that all consumers and businesses are served over broadband infrastructure capable of meeting the needs of today and the future, the State's candidate broadband goals—subject to funding availability—should be as follows:

- **Candidate 5-year goal**: 90 percent of Alabama consumers and businesses will have access to 100/20 Mbps broadband service. Where public funds are used to deploy broadband, consumers and businesses will have access to 100/100 Mbps service over networks capable of cost-effectively scaling up to 1/1 Gbps. Reaching this goal would enable the State to cut in half its current total of unserved households.

- **Candidate 10-year goal:** 98 percent of Alabama consumers and businesses will have access to 100/20 Mbps service over networks capable of cost-effectively scaling to 100/100 Mbps.

4.2 Infrastructure and grant programs

In order to ensure that the State's grant program maximizes the impact and value of public funds in the near and long-term, certain key principles should be followed.

1. To the greatest extent possible, public funds will be used to deploy infrastructure with a lifetime measured in decades, not years, so that the State's investment has long-term value
2. Public funds will be leveraged to attract and increase private broadband investment in Alabama—not to replace it
3. Grant programs will be designed to incentivize widespread deployment rather than cherry-picking of the most attractive areas
4. Once the State funds an area, the network should be self-supporting going forward and not eligible for additional State funding
5. State grants will require that grantees meet measurable concrete, enforceable obligations

In light of those principles, this plan makes the following recommendations.

4.2.1 Expand and adapt existing grant program

The grant program parameters and scoring should be adapted to reflect the recommended principles in the following ways:

- Offer variable match requirements as low as 20 percent based on the cost to construct each serviceable passing
- Prioritize delivery of future-proof solutions that will not require future State support
- Offer customized timeline for completion requirements for larger projects
- To maximize alignment with federal funding opportunities, provide ADECA maximum flexibility in timing for grant applications and review
- Prioritize demographic reach to lower-income areas as well as more economically attractive affluent areas
- Provide extra points for cost-effectiveness and also for Alabama-based ISPs, to enable both large and smaller companies to compete for public funds, as allowed

4.2.2 Develop a middle-mile grant program

Discussions with ISPs, particularly with smaller ISPs, have demonstrated the gaps that exist in middle-mile infrastructure, especially in unserved areas. Bridging these middle-mile gaps would enable more cost-effective construction and operations in the last-mile and creates opportunities for innovation.

In alignment with State statues that already reflect the need for middle-mile, at least 10 percent of 2022 grant funding should be dedicated to middle-mile to encourage and incent last-mile deployment and enable innovation and opportunity.

This plan also recommends the State launch a voluntary data collection effort to inform further allocations of funds, including showing efforts to access existing middle-mile.

4.2.3 Develop a line extension grant program

This program would focus on bringing broadband to unserved pockets within otherwise served areas. Discussions with ISPs through the process of creating The Alabama Broadband Map have identified numerous such unserved pockets, which are different from the usual large contiguous unserved areas. Addressing these unserved pockets would be most efficiently accomplished through line extensions by the ISPs that already serve the surrounding areas.

This plan recommends that the State create a line extension grant program for 2022 on a pilot basis to test ISP appetite for this approach in areas that are not eligible for other ADECA funding. These grants should fund both extension along low-density roads and deployment on long driveways because both scenarios represent investments that are not viable for private investors alone. That said, grantees should be precluded from requiring additional contributions from consumers in aid of capital expenditures.

4.2.4 Review strategy as needed to align priorities with funding sources

As-needed review of these grant programs should be undertaken to ensure the State’s efforts are designed to maximize the potential for federal support to Alabama’s ISPs. The federal broadband funding environment is fast-changing and will require frequent strategic analyses of how to optimize state programs.

For example, IIJA requires a Digital Equity plan (see Section 0). IIJA also includes provisions that are contrary to State legislation, such as prohibiting public entities from receiving awards.

More changes may come, too, as new FCC and agency appointments likely shift federal funding strategies.

4.3 Data and mapping

Without comprehensive and up-to-date data and mapping, the State risks making suboptimal decisions on how to deploy limited funding resources, potentially limiting the impact this funding can make on improving residents' lives and achieving better economic outcomes. To ensure the State has the information needed to make decisions, the plan makes the following recommendations.

4.3.1 Update The Alabama Broadband Map annually

The Alabama Broadband Map is a critical tool for policymaking, grantmaking, and representing Alabama's interests in Washington. In order to keep this map up-to-date, ADECA should:

- Require participation in the mapping process as a precondition for applying for grants
- Seek to formalize in legislation aspects of the Map that protect ISPs' interests and encourage participation, such as:
    - ADECA's authority to enter into agreements to protect ISPs' proprietary data
    - ADECA's authority to share data with federal authorities to support State interests
    - Data requirements of ISPs, including actual download/upload speeds, technology type, latency, and type of premises services (business or residence)

ADECA should also use the Map to participate in the challenge process to the FCC map to ensure proportional and fair federal funding for Alabama.

4.3.2 Use the Map as the critical tool for ISPs to protect their interests

The Map can serve to expedite grantmaking by separating the challenge process from the grant program. ADECA should allow for challenges in the form of data updates to the Map rather than as part of the grant program. This approach would enable ADECA to leverage the Map to ensure that funded grant applications will be for areas of the State that are unserved according to the Map. This would create a more efficient, impactful grant program while giving ISPs a full and fair opportunity to participate in the mapping process to protect their interests.

The community feedback period and ISP update period are intended to improve on the current challenge process. Similarly, legislation should be updated to remove the challenge process from the grant process.

4.3.3 Support small Alabama ISPs with compliance with FCC mapping requirements

The FCCs emerging mapping program contains considerably more burdensome reporting requirements than does The Alabama Broadband Map. While larger companies have the resources for this effort, some small Alabama ISPs may be overly burdened and struggle to comply. With modest effort ADECA can support smaller ISPs in this area, as it does in analyzing grant opportunities and other matters. Overall, this effort would relieve the burden on small Alabama companies.

4.4 State and local collaboration

Fostering collaboration between the State and local governments is essential to maximizing the efficiency and impact of grant programs.

4.4.1 Support local planning through technical assistance

The goal of this approach is to enable local communities to be effective partners to the State and private ISPs. Local governments play multiple key roles in broadband deployment—as asset owners, volume consumers, ISP partners, permitting authorities, and representatives of the public.

ADECA's technical assistance program should be continued and expanded to include:

- An ongoing webinar series regarding grant opportunities and partnership approaches
- Preparation of local/regional plans with similar components (and alignment with) the State plan

This work is already funded for 2022 through ADECA's successful EDA grant application.

4.4.2 Support local communities to challenge the FCC map

The FCC mapping process will include opportunities for challenges from communities. The Alabama Broadband Map, along with local data, will be singular tools in enabling communities to vet and challenge the FCC map if necessary. The goal of challenging the FCC's map is to enable local communities to protect their interests; the communities will benefit from coaching and support from ADECA that will enable efficient analyst and responsiveness to the FCC.

4.4.3 Allow localities to contribute a portion of matching funds

Many Alabama communities have expressed interest in funding broadband deployment in their areas, but they have reasonable concerns about compliance with federal requirements under the American Rescue Plan Act. Allowing local contributions to private ISP match obligations for the State grant program would address this concern and offer additional benefits: This approach would increase the reach of ISP deployments by increasing the total capital available to ISPs. It would also encourage private ISPs to engage with local communities and seek to address their needs through such partnerships.

To ensure ISPs have made a sufficient commitment, localities should not be able to contribute more than 30 percent to 50 percent of an ISP's match obligations.

4.5 Broadband affordability and adoption

Broadband adoption depends on the availability of infrastructure, the affordability of services, and other factors.

4.5.1 Maximize the benefits of federal subsidy programs for consumers and companies

Increased use of the federal subsidy programs has multiple public and private sector benefits. Participation in ISP and federal low-income programs that offer broadband subsidies is generally low. This low participation is largely because of a lack of information and lack of trust. Increasing participation will get more people online while also increasing the feasibility of deploying broadband to lower-income areas.

ADECA and ALDSE programs have increased participation in the Emergency Broadband Benefit relative to other states and programs. This work should be continued. ADECA should develop a multi-pronged public outreach campaign to connect consumers to ISPs for subsidy programs. The campaign could include:

- Educational materials to public, educational, and non-profit entities
- Technical assistance for eligible consumers
- Partnerships with trusted community benefit organizations and non-profits to educate eligible consumers

4.5.2 Expand contact center efforts to support consumers to access federal subsidies

Alabama is regarded as a national leader in efforts to support low-income broadband consumers. ADECA already receives numerous calls from consumers seeking guidance but does not have the capacity to respond. ADECA and ALSDE have pioneered contact center efforts to support student families to connect to ISPs for service. This approach should be expanded to all demographics, including seniors. The contact center could also connect low-income families with localities and community-based organizations that offer training for digital skills and other support.

4.5.3 Develop a grant program for digital skills

National and State data demonstrate that the availability of broadband connectivity is insufficient alone to enable residents to successfully use the internet. Broadband adoption also requires digital skills, which not everyone has. This lack of skills is particularly challenging for seniors and low-income adults.

This gap could be addressed through a competitive grant program to fund skills training by experienced, able entities, including potential partners such as:

- Community action agencies

- Alabama Public Library Service
- AARP and other non-profit entities

The focus of these grants should be on all demographics, including seniors.

4.5.4 Develop a voluntary ISP program to support low-income consumers

Many ISPs have not yet developed support programs for lower-income customers, even as larger ISPs have done so. With ADECA's support, this planning could be value to ISPs and to consumers. A win-win program for ISPs would be analogous to the voluntary electric support programs that are widely offered in the electric industry.

This plan recommends the development of joint initiatives between ADECA and ISPs—beginning with a convening to encourage companies to create programs. The ADECA contact center could help eligible residents connect with ISPs to become customers. Participating ISPs could receive additional weight in grant scoring for including these programs.

Appendix A: Service providers and stakeholders engaged during preparation of this plan

ADECA engaged in interviews with representatives of a wide range of service providers and stakeholders during preparation of this plan:

Service providers

1. C-Spire
2. Charter
3. Comcast
4. Central Alabama Electric Cooperative
5. Farmers Telecommunications Cooperative
6. Millry Communication Corp.
7. Mediacom Communications Corp.
8. JTM Broadband
9. Traveller Multimedia Corp.
10. T-Mobile
11. Verizon
12. Southern Linc

Stakeholders

1. Alabama Public Library Service
2. Thrive Regional Partnership
3. Alabama Supercomputer Authority (ASA)
4. Alabama Rural Electric Association of Cooperatives (AREAC)
5. Alabama Power
6. Alabama League of Municipalities (ALM)
7. Association of County Commissions of Alabama (ACCA)
8. Alabama Hospital Association (ALaHA)
9. American Association of Retired Persons (AARP)

Appendix B: High-level engineering design and cost estimate for candidate infrastructure solution

ADECA's project team developed a conceptual, high-level fiber-to-the-premises (FTTP) outside plant network design and cost model to provide connectivity to currently unserved addresses within Alabama. The model was designed to only target unserved areas and to act as extensions to existing service providers' networks. The design is aligned with industry best practices and would be able to support a variety of electronic architecture options and service providers.

The following presents two designs with differing assumptions as to which addresses would be served:

- **Model A** assumes service will be extended to the roughly 242,000[25] addresses that currently are unserved by speeds of 25 Mbps download and 3 Mbps upload (25/3)
- **Model B** includes the same addresses but adds addresses that are currently unserved by speeds of 100 Mbps download and 20 Mbps upload (100/20)—a total of 357,500 addresses

Model A will cost an estimated $2.8 billion for the distribution plant, or $11,550 per address. Distribution network electronics, subscriber drops, and customer premises equipment (CPE) for Model A at a 100 percent take-rate would cost an estimated $350 million, or $1,400 per address. In total, Model A is estimated to cost $3.15 billion, or $13,000 per address, with a 15 percent increase applied to account for necessary middle mile and interconnection elements and an additional 15 percent contingency applied to address labor and material shortages. **The total cost for Model A, after applying these increases, is $4.1 billion.**

Model B will cost an estimated $3.0 billion for the distribution plant, or $8,500 per address. Distribution network electronics, subscriber drops, and CPE for Model B at a 100 percent take-rate would cost an estimated $500 million, or $1,400 per address. In total, Model B is estimated to cost $3.5 billion, or $10,000 per address, with a 15 percent increase applied to account for necessary middle mile and interconnection elements and an additional 15 percent contingency applied to address labor and material shortages. **The total cost for Model B, after applying these increases, is $4.5 billion.**

These costs are summarized in Table 5.

[25] As discussed in more detail below in "Network Design," the unserved address numbers in both Model A and Model B were increased by 15 percent, relative to the numbers in Table 1 in the main body of the report, to account for missing addresses, such as parcels that may contain unserved addresses that were not present in the address point data.

Table 5: Estimated capital cost of statewide FTTP distribution network and electronics

	Model A	**Model B**
Addresses	242,000	357,500
Distribution plant	$2,800,000,000	$3,000,000,000
Cost per address	$11,550	$8,500
Electronics, subscriber drops, and CPEs	$350,000,000	$500,000,000
Cost per address	$1,400	$1,400
Middle mile and interconnection	$472,500,000	$525,000,000
Contingency: labor and material supply	$472,500,000	$525,000,000
Total estimated cost	**$4,095,000,000**	**$4,550,000,000**
Cost per address	**$17,000**	**$12,800**

Objectives and key attributes

Both models would provide unserved Alabamans with cost-effective and flexible infrastructure—optimized for long-term use. The key design criteria for the network include:

- Providing service to the unserved addresses in the State, with capacity for future growth
- Only building in areas that are currently unserved, with minimal to no overbuilding in areas that are already served

The cost estimate is based on an FTTP hierarchical data network that would provide scalability and flexibility, both in terms of initial network deployment and ability to accommodate the increased demands of future applications and technologies. The central characteristics of this hierarchical FTTP data network include:

- **Capacity** – ability to consistently provide efficient transport for subscriber data at advertised speeds, even at peak times
- **Availability** – high levels of reliability and resiliency; the ability to quickly detect faults
- **Scalability** – ability to grow in terms of physical service area and increased data capacity, and to integrate newer technologies without new construction

This architecture offers scalability to meet long-term needs. It is consistent with best practices for either a standard or an open-access network model to provide customers with the option of multiple network service providers. This design would support Gigabit Passive Optical Network (GPON) technology—the current industry standard—as well as emerging 10 Gbps XGS-PON and NG-PON2 standards. It could also provide the option of direct Active Ethernet (AE) services on a limited basis, such as for business customers, using spare fiber capacity built into the designs.

Assumptions and criteria

The cost of building FTTP infrastructure will depend in large part on what percentage of the network infrastructure is attached to aerial poles as opposed to being constructed in underground conduit. Based on our analysis, the FTTP design will employ 90 percent aerial fiber and 10 percent underground fiber.

In addition, the infrastructure design and cost estimates assume the infrastructure will:

- Use manufacturer-terminated fiber tap enclosures within the public right-of-way or easements, providing watertight fiber connectors for customer service drop cables and eliminating the need for service installers to perform splices in the field. This is an industry-standard approach to reducing both customer activation times and the potential for damage to distribution cables and splices.
- Serve all unserved addresses according to the criteria of each model.
- Not be built in any areas identified as currently served.

The network infrastructure was defined based on the following criteria:

- Underground conduit and fiber will be installed in the public right-of-way or in an easement on the side of the road.
- The aerial fiber design will make use of existing poles where possible.
- Fiber sizes will range from 216 to 288-count cables; short laterals and drop fiber will contain six to 12 strands.
- The network will target up to 288 parcels per secondary distribution point, each served from a fiber distribution cabinet (FDC) containing optical splitters.
- Distribution plant will terminate at multi-port subscriber tap terminals (i.e., “taps”) in underground handholes, each serving no more than 12 parcels.
- Access conduit will be placed in drop access handholes placed at the edge of the parcel for each serviceable parcel (i.e., one handhole per one or two parcels).
- Underground vault spacing will be no more than 750 feet along distribution routes.
- Where possible, the distribution plant network routes will avoid crossing major roadways, railways, and waterways.

We reviewed GIS and Google Street View data to sample pole conditions and estimate the percentage of poles requiring make-ready in segments of the FTTP infrastructure. We extrapolated the data to estimate make-ready costs and determine the percentage of the network routes that can utilize aerial infrastructure.

Based on that analysis, we estimate the following construction characteristics:[26]

- 84 percent of the network routes have a small number of poles requiring make-ready or replacement
- 4 percent of the network routes have a moderate number of poles requiring make-ready and some replacement
- 12 percent of the network routes have poles requiring a large amount of make-ready and a large amount of replacement

We applied a 100 percent take-rate to certain costs—that is, we budgeted so that the residents living at every parcel served by the network receive the service. This quantity affects the costs of the network electronics needed to serve the network and the costs for deploying drops to subscribers on the network.

Conceptual design

The FTTP network will be built only in unserved areas; ISPs currently serving adjacent areas will connect to the State's primary distribution conduit at meet points.

The primary distribution conduit will be fed through distribution vaults. Some distribution vaults will be designated as equipment vaults; these will contain splitters to feed secondary distribution conduit to tap access handholes located near residents. Each tap access handhole will then connect to drop access handholes located on the edge of the parcel but still within the right-of-way. Drops can be constructed from either a tap access handhole or a drop access handhole. Installing infrastructure all the way to the edge of each premises' parcel will reduce costs for future installation to a subscriber.

Network design

We present two designs with differing assumptions as to which addresses would be served:

- **Model A** assumes the network will target the roughly 241,850 addresses that currently are unserved by speeds of 25 Mbps download and 3 Mbps upload (25/3)
- **Model B** includes the same parcels but adds addresses that currently are unserved by speeds of 100 Mbps download and 20 Mbps upload (100/20)—a total of 357,500 addresses

[26] The total exceeds 100 percent because the individual percentages have been rounded.

To identify served and unserved addresses, we analyzed the best available commercial data and county parcel data, as well as service data provided by internet service providers. We combined the parcel data and address points from these sources to determine which parcels contained served or unserved addresses. However, none of the address data sources are fully complete. When comparing the data sources to the data of the internet service providers, along with field inspection, and review of photometry, we determined that the cost estimate needed to account for a likely undercount of the unserved addresses.

To build FTTP infrastructure with the available data while also accounting for the existence of unserved addresses, we used a route-finding algorithm to design a statewide FTTP network to build continuous infrastructure to all parcels identified as containing an unserved address. Then, to account for missing addresses, such as parcels that may contain unserved addresses that were not present in the address point data, we increased the number of unserved addresses by 15 percent. (This percentage increase was based on around the number of addresses identified, the number of addresses in Alabama as a whole, and experience in similar analyses).

Figure 29 and Figure 30 illustrate the candidate FTTP network for Model A, while Figure 31 and Figure 32 show the FTTP network for Model B.

Figure 29: Initial statewide FTTP design for Model A

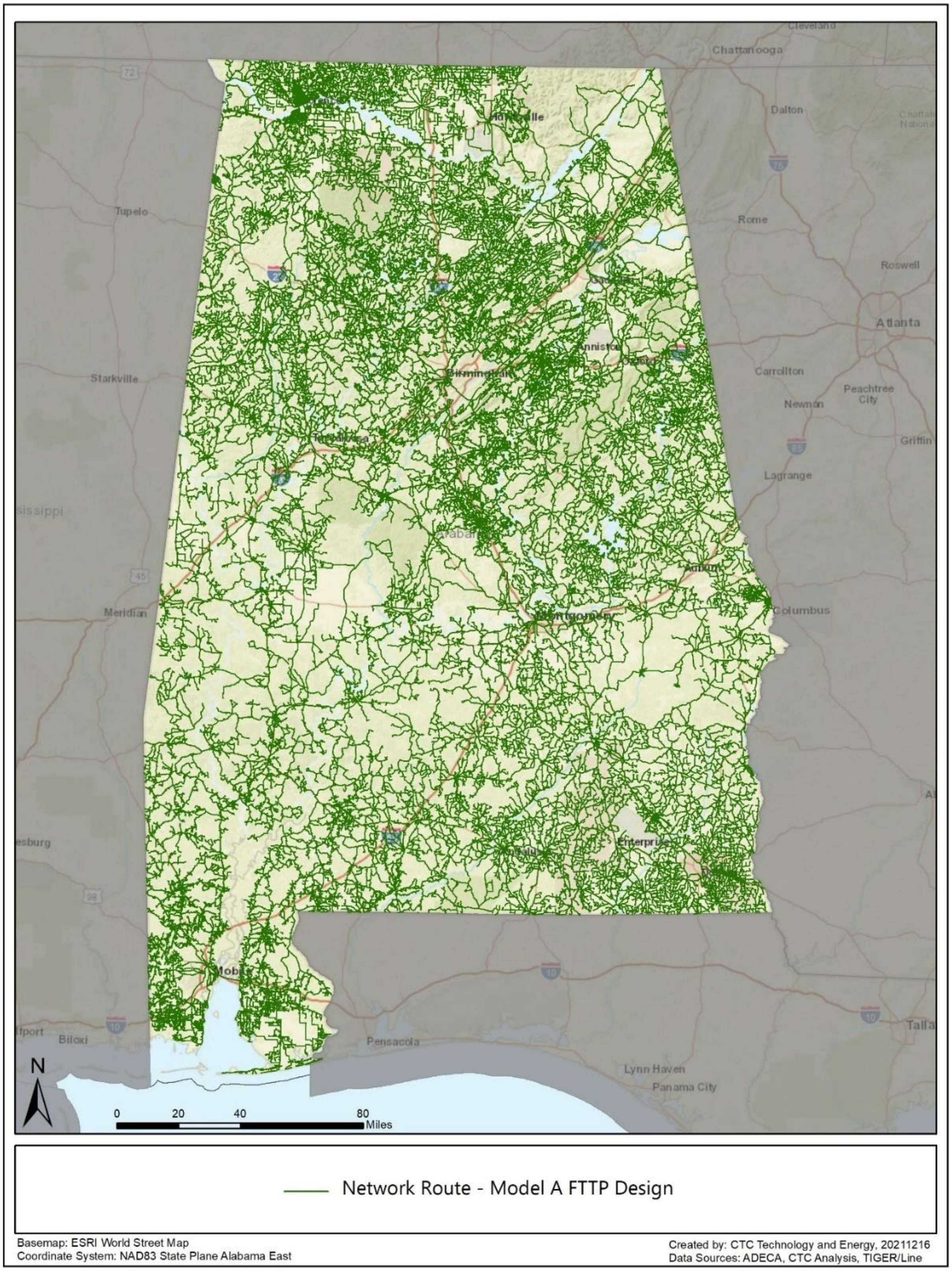
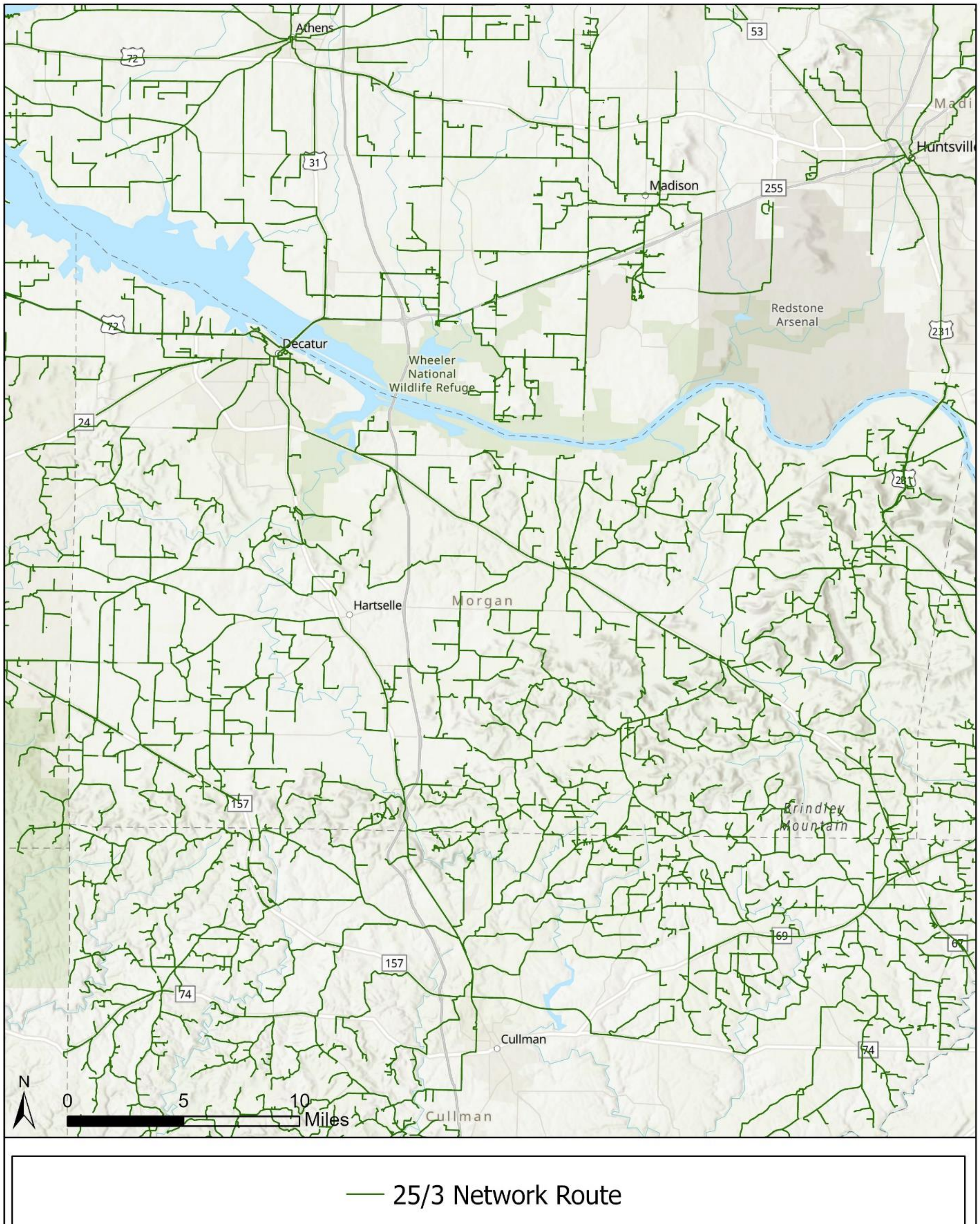


Figure 30: Close-up of initial statewide FTTP design for Model A



Basemap: ESRI Topographic
Coordinate System: NAD 1983 StatePlane Alabama East

Created By: CTC Technology and Energy, 2021220
Data Sources: ADECA, CTC Analysis, TIGERline

Figure 31: Initial statewide FTTP network for Model B

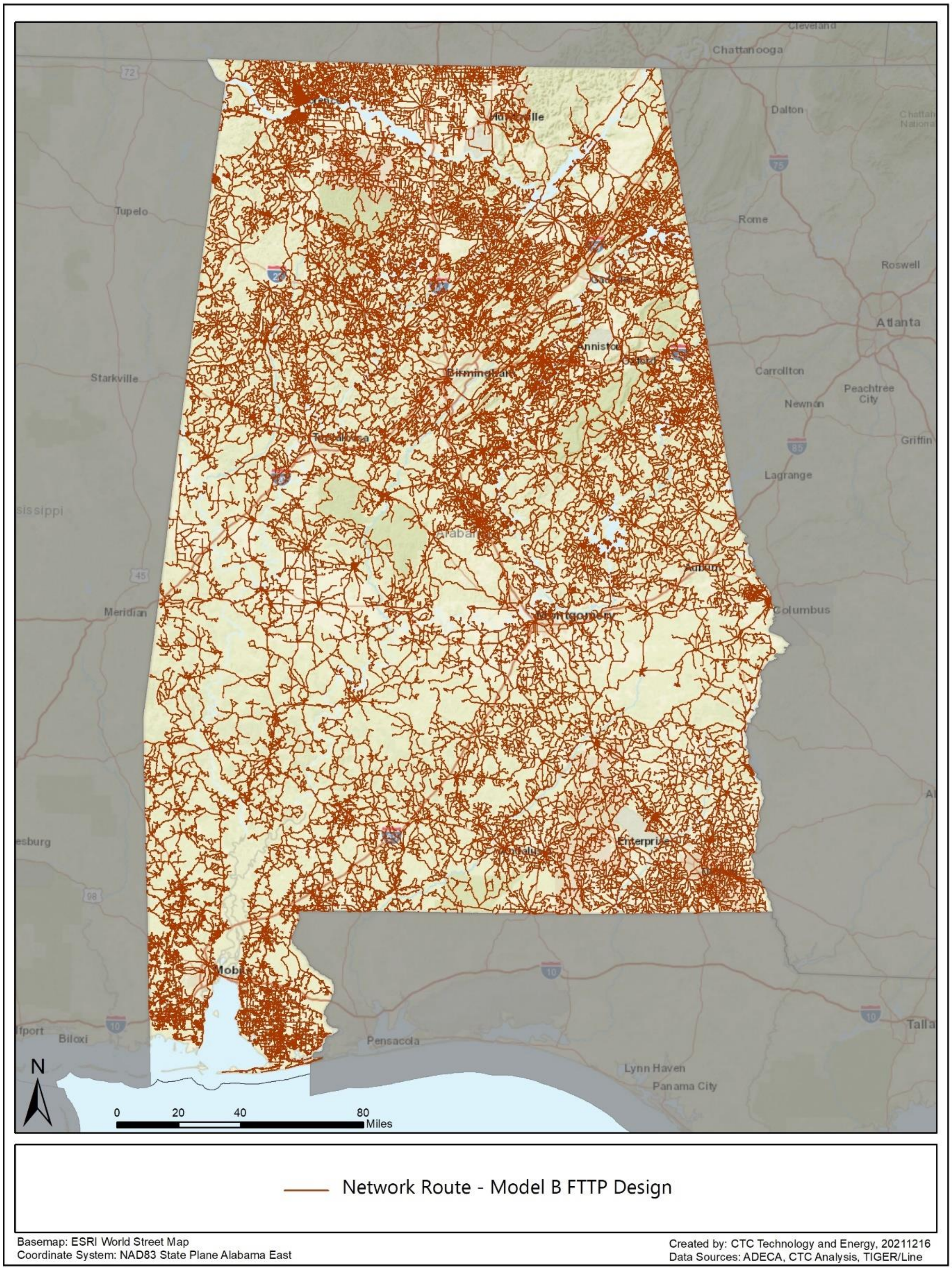
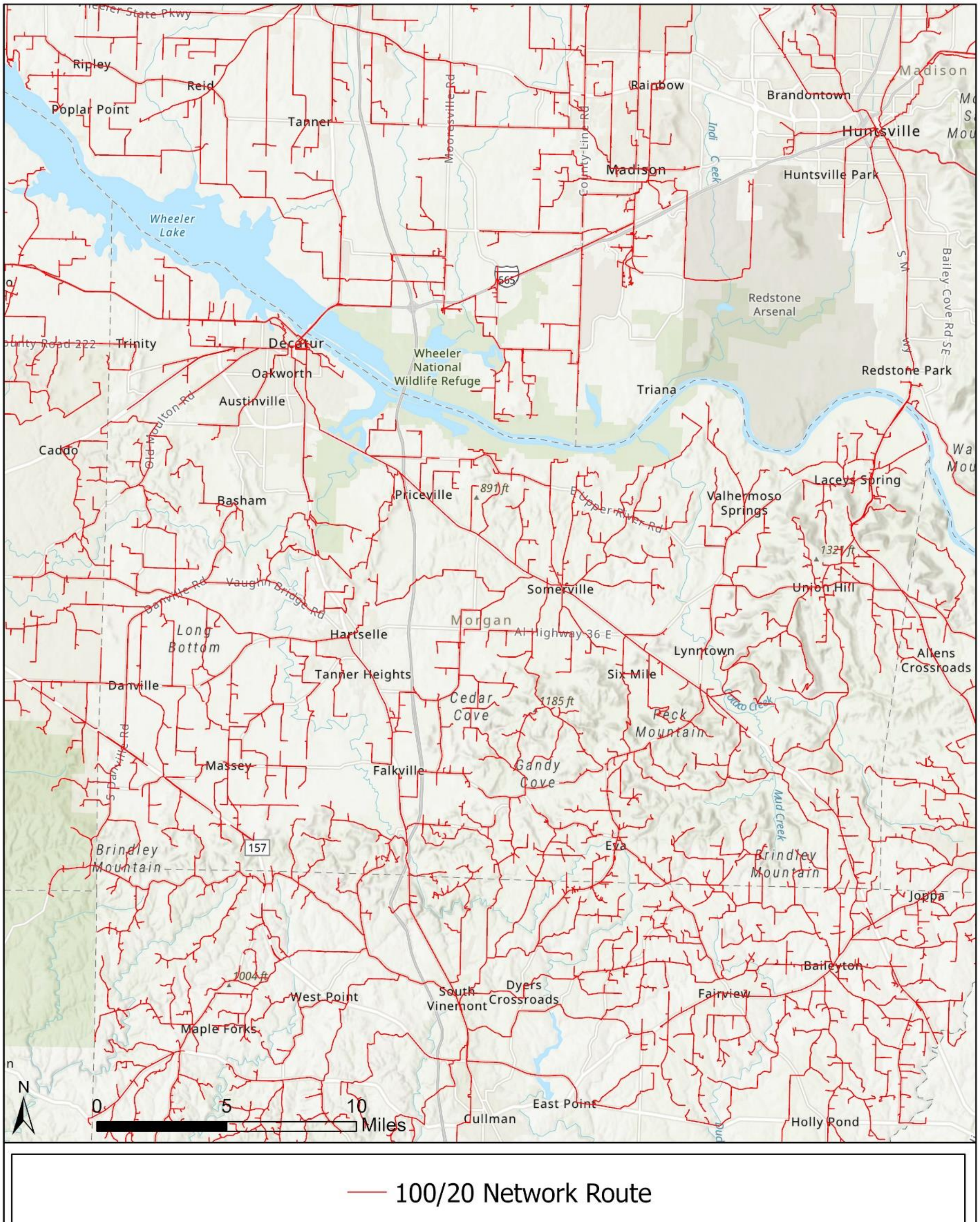


Figure 32: Closeup of initial statewide FTTP Design for Model B



Basemap: ESRI World Streetmap
Coordinate System: NAD 1983 StatePlane Alabama East

Created By: CTC Technology and Energy, 2021216
Data Sources: ADECA, CTC Analysis, TIGERline

We then conducted an analysis to determine how much of the FTTP network created by the algorithm traveled though areas that are already served by an ISP, and thus constituted overbuild in areas where additional broadband infrastructure was not need.

As a first step in this analysis, we divided the State into a grid of equally sized cells and conducted a density study of a sample of 30 grid cells. We analyzed the density of unserved parcels in each cell to categorize them as a low, medium, and high density of unserved parcels. We then used the proportionality of low, medium, and high-density grid cells and applied this ratio to all grids in the State to develop a density map of unserved addresses throughout the State.

Figure 33 and Figure 34 show the results of the density analysis for Model A and Model B, respectively.

Figure 33: Unserved parcel density analysis of Model A

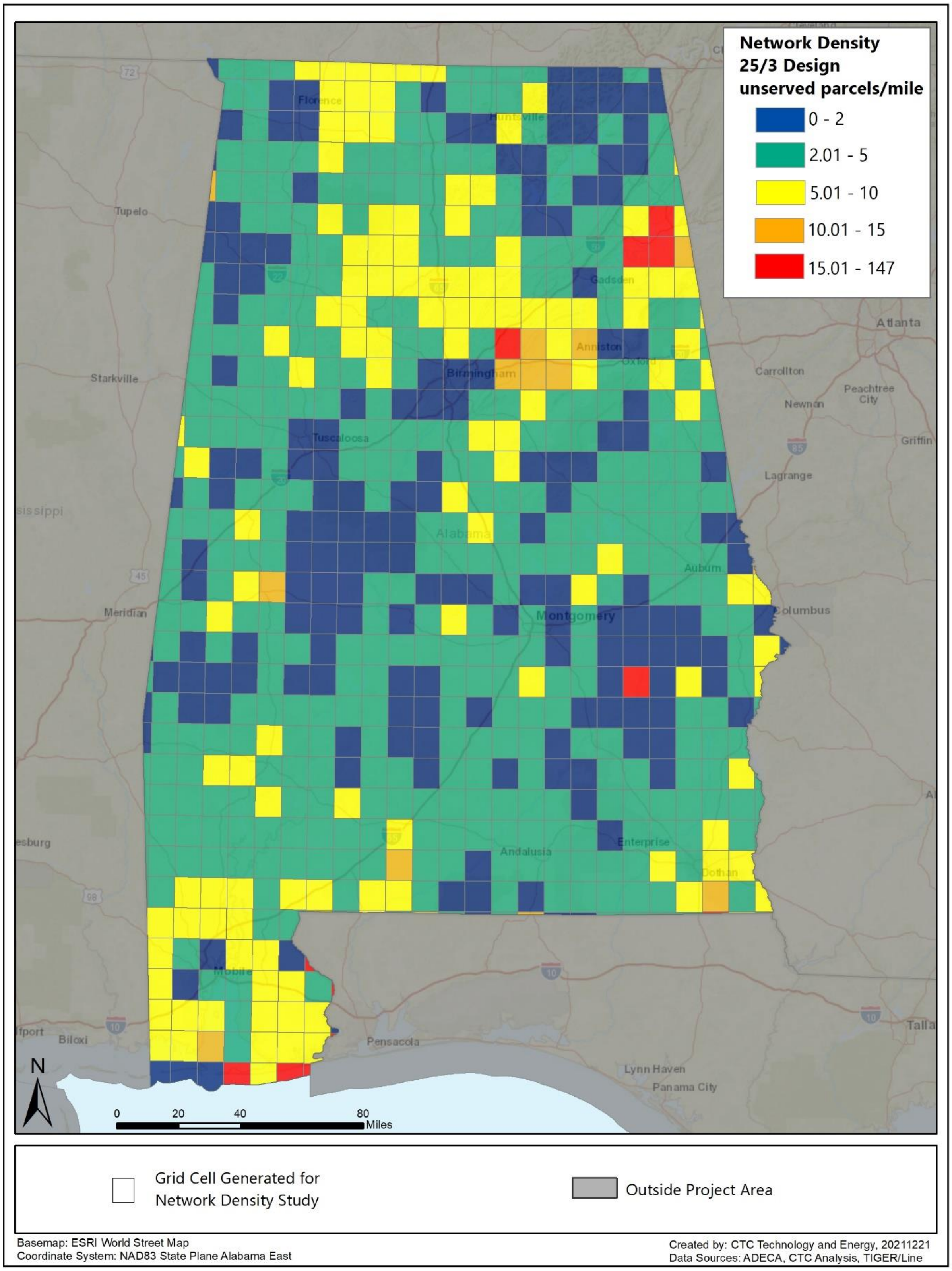
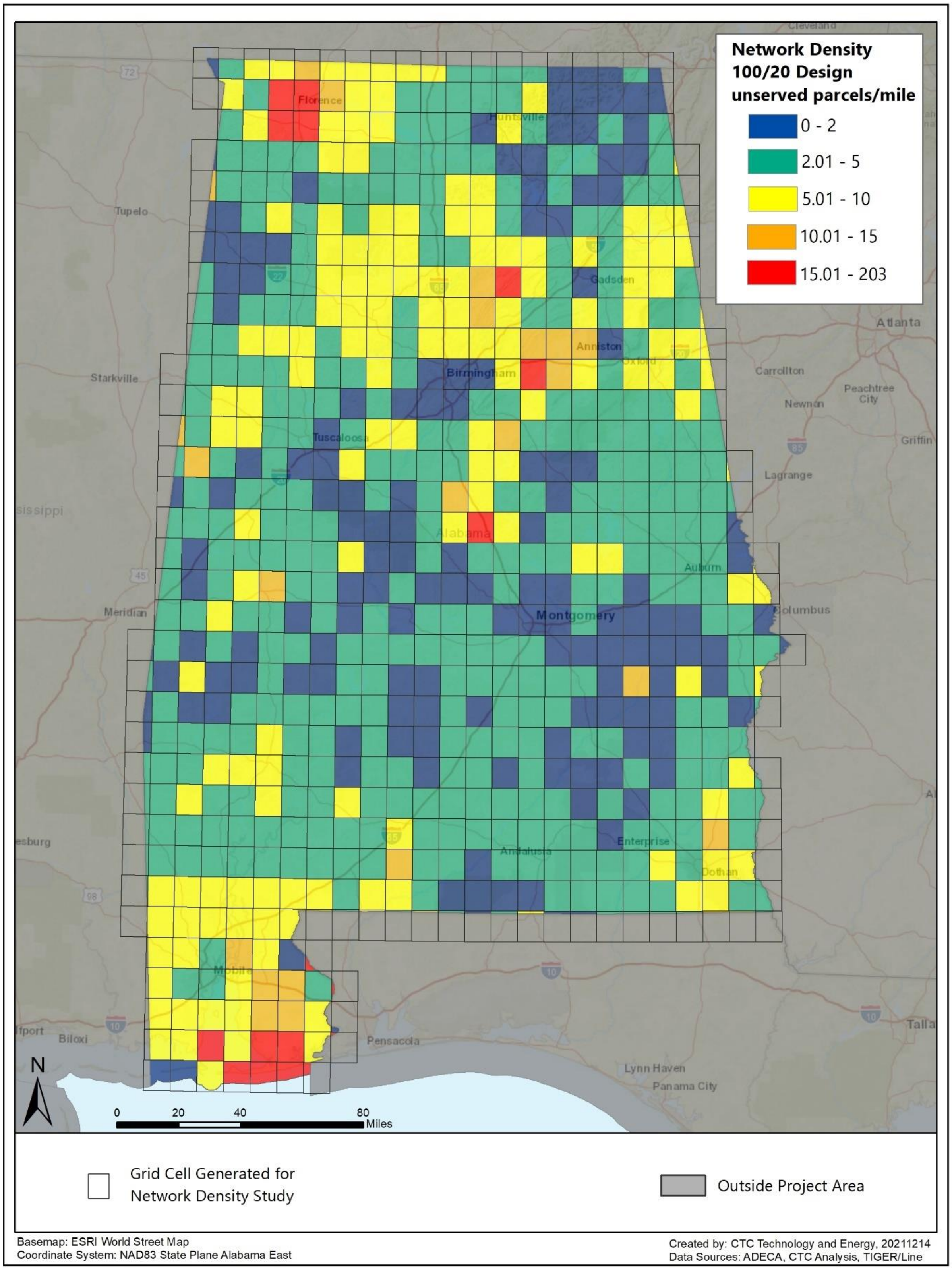


Figure 34: Unserved parcel density analysis of Model B



Based on the estimated density of unserved addresses in a particular grid, we estimated how much of the designed FTTP infrastructure inside a cell would be overbuild of existing plant, and we removed the overbuild of existing infrastructure from the estimated cost. The resulting cost estimate estimates only the remaining FTTP infrastructure after the served areas have been removed, which then represents only FTTP infrastructure in areas that are unserved.

As an example, Figure 35 shows a close-up of one sample grid cell used in the analysis for Model A. The designed FTTP network (orange lines) travels through areas of served addresses (green dots) to get to unserved addresses (red dots). The majority of the designed network in this cell travels through neighborhoods that are already served and do not need additional broadband infrastructure. By assuming the new infrastructure in the unserved areas could be built as an extension of the existing infrastructure, the portions of the FTTP network running through the served area could be removed, reducing the cost of construction.

Figure 36 shows the grid cell after the FTTP network has been analyzed and divided into overbuild in served areas (orange lines) and new build in unserved areas (blue lines). Figure 37 shows the final FTTP network with the overbuild removed.

Figure 35: Sample grid cell showing original FTTP network

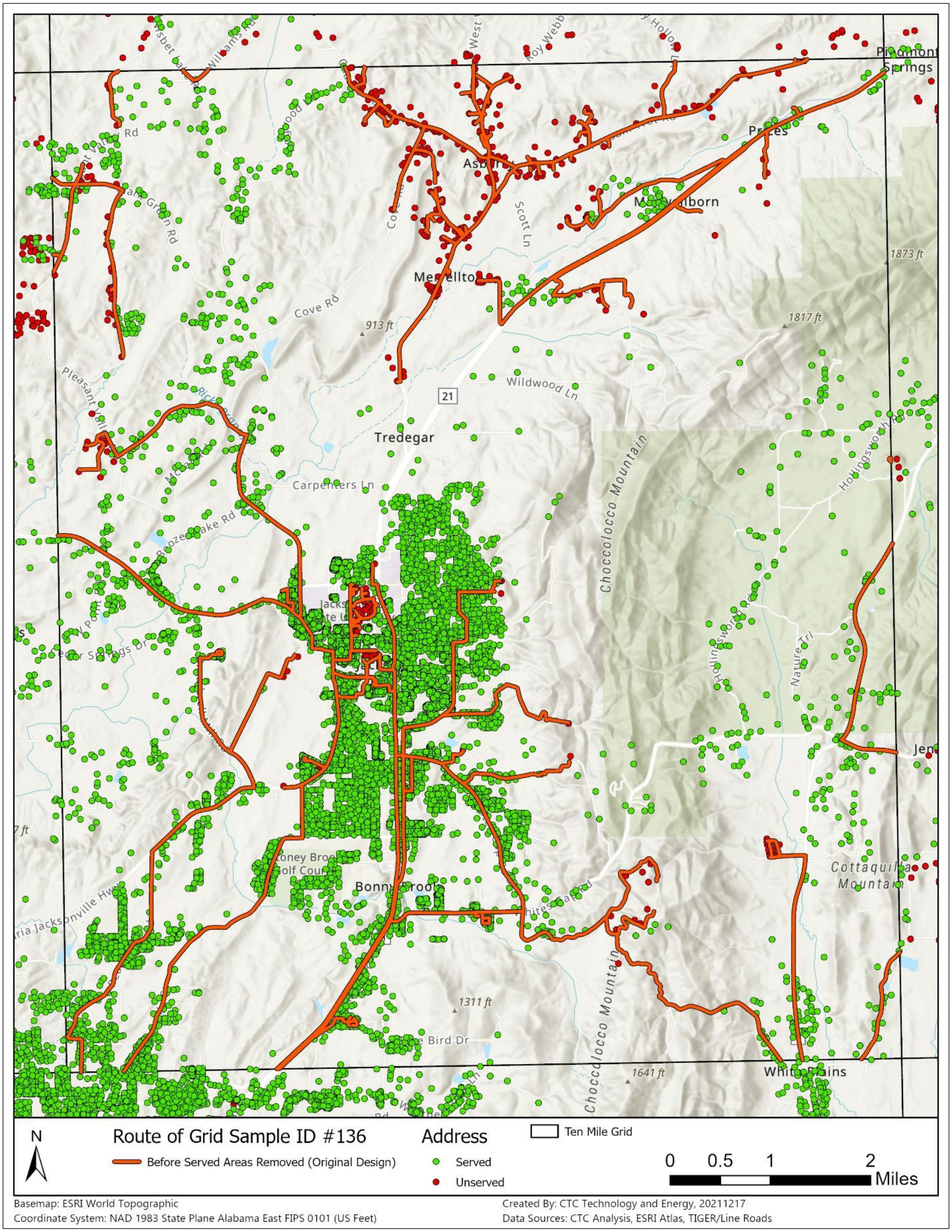
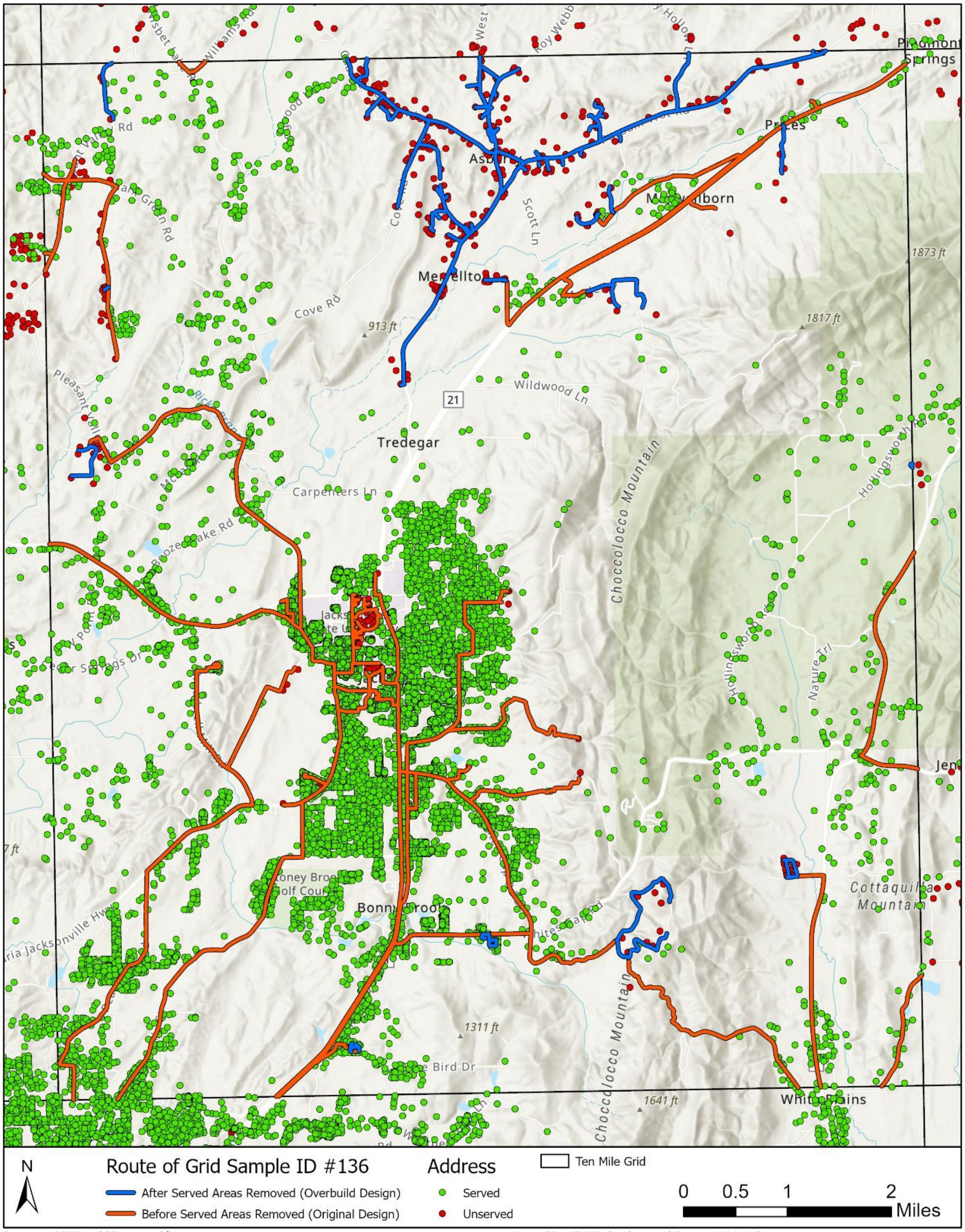


Figure 36: Sample grid cell showing FTTP network in served and unserved areas



Basemap: ESRI World Topographic
Coordinate System: NAD 1983 State Plane Alabama East FIPS 0101 (US Feet)
Created By: CTC Technology and Energy, 20211217
Data Sources: CTC Analysis, ESRI Atlas, TIGER/Line Roads

Figure 37: Sample grid cell with overbuild removed

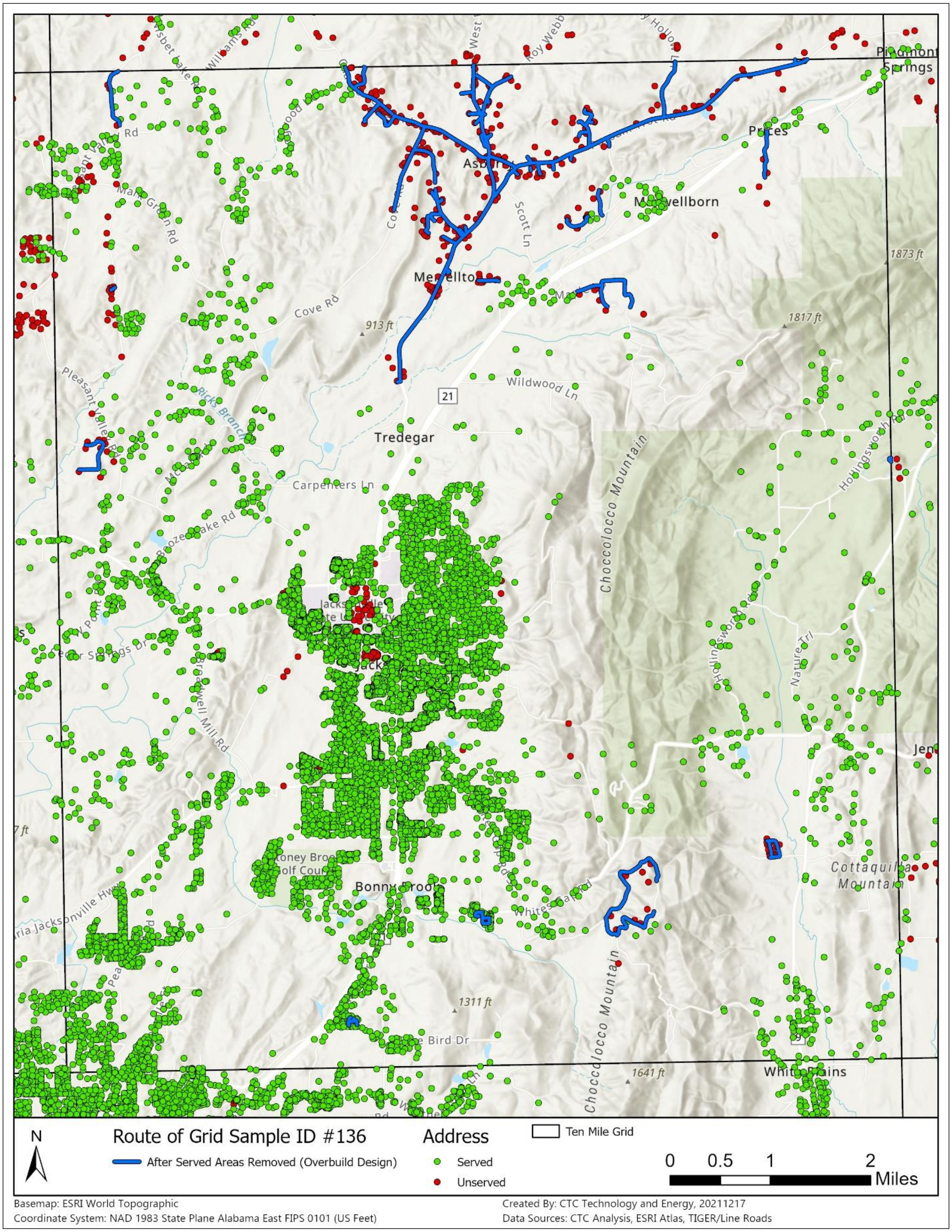


Figure 38 and Figure 39 overlay served addresses on top of the initial FTTP network, representing overbuild areas removed from the FTTP cost estimate. The remaining FTTP infrastructure is shown in blue.

Figure 38: Model A design and areas served by 25/3 Mbps

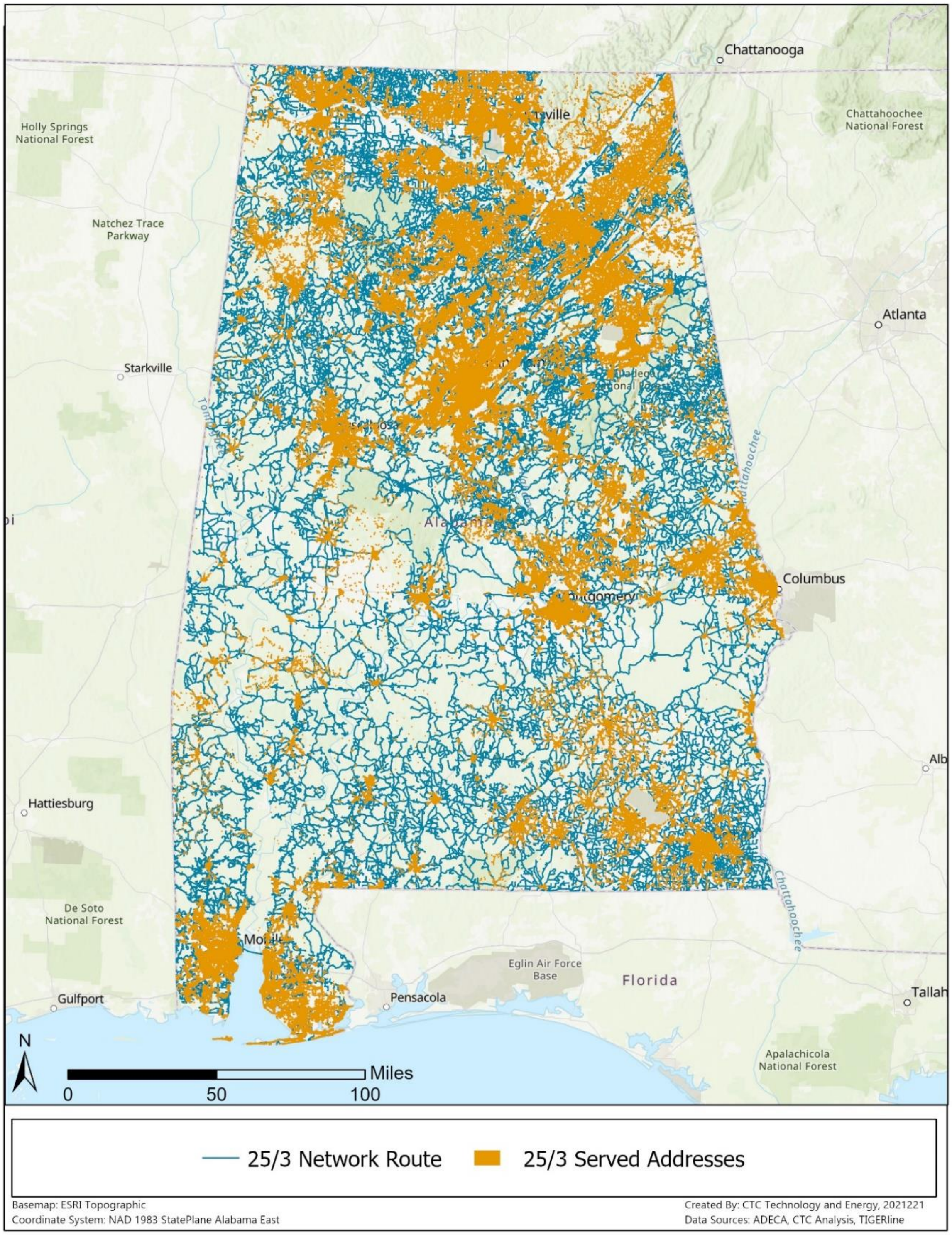
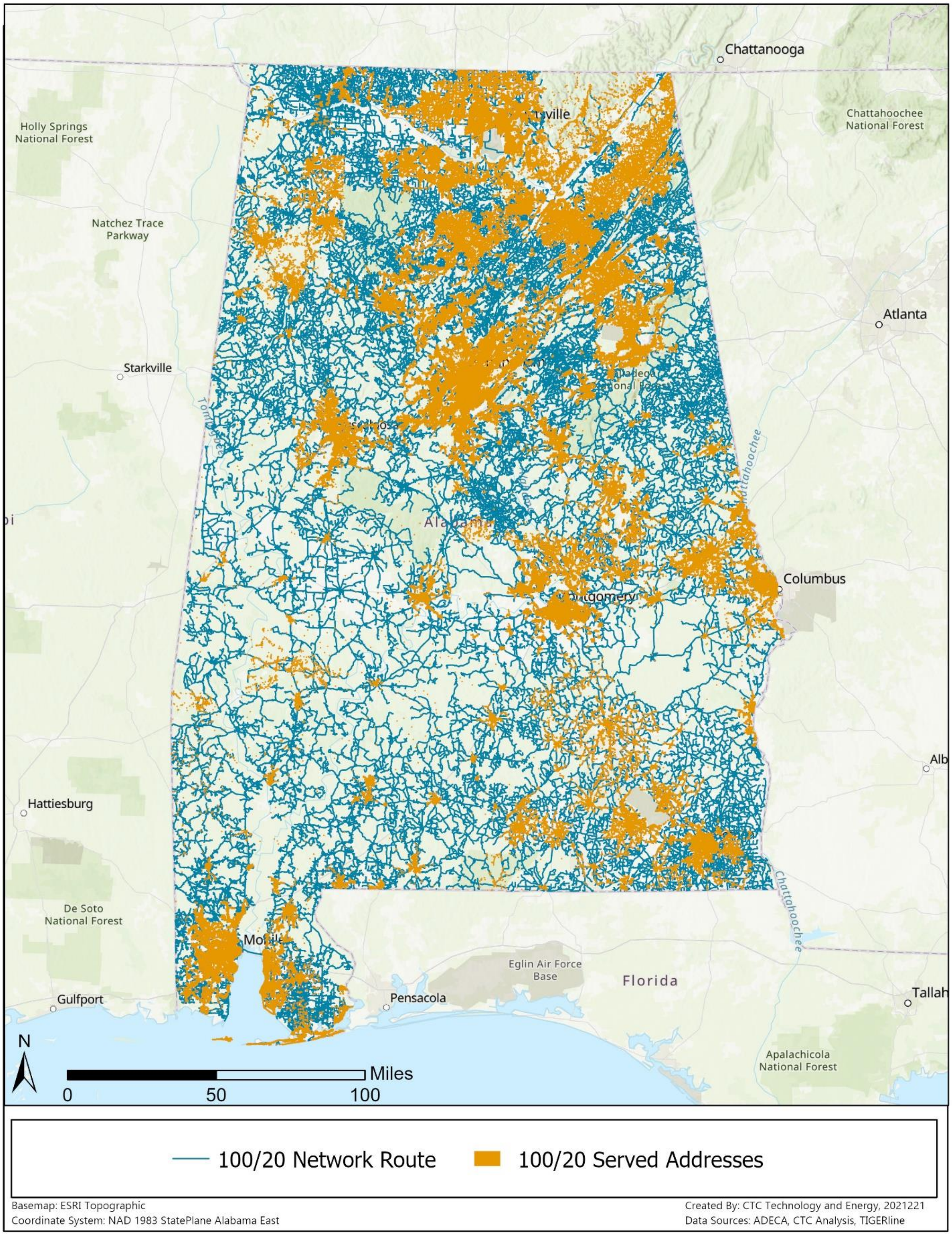


Figure 39: Model B design and areas served by 100/20 Mbps



The following cost estimates utilize the estimate containing the 15 percent increase in addresses and does not include overbuild inside currently served areas.

Capital costs for a statewide network

The cost for the distribution plant includes the following elements:

- **Project management** – encompasses overall project and contract management, including oversight of the construction and engineering contractor(s), equipment suppliers, and right-of-way agreements; we assumed a four-person project management team for three years.
- **Engineering and as-builts** – includes system-level architecture planning, preliminary designs, and field walk-outs to determine candidate fiber routing; development of detailed engineering prints and preparation of permit applications; and post-construction "as-built" revisions to engineering design materials.
- **Conduit and vault infrastructure** – consists of all labor and materials related to underground communications conduit construction, including conduit placement, vault/handhole installation, and surface restoration; includes all work area protection and traffic control measures inherent to roadway construction activities.
- **Utility pole make-ready** – consists of the labor needed for preparing poles for the addition of new aerial cabling. This includes moving existing cables to make room for new cables or replacing poles if the existing pole is at maximum capacity.
- **Fiber optic cables and components** – consists of the material and labor costs specific to the installation of fiber optic cables, taps, splice enclosures, and other related components, irrespective of the cable pathway (underground conduit or aerial placement).
- **Fiber splicing, testing, and documentation** – includes all labor related to splicing of outdoor fiber optic cables.
- **Construction contingency**

The estimated total cost for distribution electronics is listed separately. We also provide the estimated cost for subscriber drops. This represents the cost for material and labor for installing aerial or underground infrastructure across a subscriber's property. This cost does not include any CPE, such as a modem.

Cost estimate for Model A

The distribution plant for Model A is estimated to cost $2.8 billion, or $11,550 per address. These costs are itemized below in Table 6. Costs have been rounded.

Table 6: Estimated distribution plant cost for FTTP Model A

Fixed Costs	
Project management	$2,750,000
Engineering and as-builts	$382,000,000
Conduit and vault infrastructure	$566,000,000
Materials	*$77,450,000*
Labor	*$488,550,000*
Aerial strand	$358,950,000
Materials	*$92,500,000*
Labor	*$266,450,000*
Utility pole make-ready	$383,700,000
Fiber optic cables and components	$819,650,000
Materials	*$596,450,000*
Labor	*$223,200,000*
Fiber splicing, testing, and documentation	$61,550,000
Backbone and distribution plan total cost	**$2,574,600,000**
Number of addresses	241,847
Cost per address	**$10,650**
Construction contingency	$219,000,000
Backbone and distribution plant total cost with contingency	**$2,793,600,000**
Cost per address	**$11,550**

Table 7 presents the estimated costs for the FTTP distribution network electronics, subscriber drop costs, and CPE.

Table 7: Estimated distribution network electronics, subscriber drop, and CPE costs (FTTP Model A)

Estimated Network Electronics and Subscriber Drop Costs for FTTP Model A	
Number of subscribers[27]	241,847
FTTP distribution network electronics	$49,600,000
Subscriber drop costs	$178,850,000
Customer premises equipment	$113,450,000
Total cost	$341,900,000
Total cost per address	$1,410

[27] At a 60 percent take-rate and inclusive of single-family homes and MDUs.

Table 8 presents the estimated total implementation costs for Model A—$4.1 billion, or $17,000 per address.

Table 8: Estimated total implementation costs for FTTP Model A

Estimated Total Implementation Costs for FTTP Model A	
Implementation costs	$3,135,500,000
Cost per address	$13,000
Middle mile and interconnection	$472,500,000
Supply chain and labor contingency	$472,500,000
Total cost	$4,095,000,000
Cost per address	$17,000

Cost estimate for Model B

The distribution plant for Model B is estimated to cost $3.0 billion, or $8,490 per address. These costs are itemized below in Table 9. Note that the costs have been rounded.

Table 9: Estimated distribution plant cost for FTTP Model B

Fixed Costs	
Project management	$2,750,000
Engineering and as-builts	$411,050,000
Conduit and vault infrastructure	$610,400,000
Materials	*$84,350,000*
Labor	*$526,050,000*
Aerial strand	$386,250,000
Materials	*$99,550,000*
Labor	*$286,700,000*
Utility pole make-ready	$412,850,000
Fiber optic cables and components	$897,450,000
Materials	*$654,100,000*
Labor	*$243,350,000*
Fiber splicing, testing, and documentation	$75,950,000
Backbone and distribution plan total cost	**$2,796,700,000**
Number of addresses	357,505
Cost per address	**$7,820**
Construction contingency (10%)	$238,300,000
Backbone and distribution plant total cost with contingency	**$3,035,000,000**
Cost per address	**$8,490**

Table 10 presents the estimated costs for the FTTP distribution network electronics, subscriber drop costs, and CPE, which is $500 million, or $1,400 per address.

Table 10: Estimated distribution network electronics, subscriber drop, and CPE costs (FTTP Model B)

Estimated Network Electronics and Subscriber Drop Costs for FTTP Model B	
Number of subscribers[28]	357,505
FTTP distribution network electronics	$73,300,000
Subscriber drop costs	$259,200,000
Customer premises equipment	$167,650,000
Total cost	$500,150,000
Total cost per address	$1,400

Table 11 presents the estimated total implementation costs for Model B.

Table 11: Estimated total implementation costs for FTTP Model B

Estimated Total Implementation Costs for FTTP Model B	
Implementation costs	$3,500,000,000
Cost per address	$8,500
Middle mile and interconnection	$525,000,000
Supply chain and labor contingency	$525,000,000
Total cost	$4,500,000,000
Cost per address	$12,800

[28] At a 60 percent take-rate and inclusive of single-family homes and MDUs.

Appendix C: Results of survey of low-income households

In November 2021, call center Ambassadors in the ABC for Students program call center reached out via telephone to 4,841 low-income households throughout the State to obtain their feedback. Telephone interviews were completed with 690 individuals, for a response rate of 14.25 percent. The maximum margin of error for n=690 at the 95 percent confidence level is +/- 3.7 percent. That is, 19 times out of 20, one would expect the survey results to be within ±3.7 percent of the actual value across the entire target population.

Survey responses were entered into the SurveyMonkey[29] online survey platform by the Ambassadors. Upon survey completion, responses were exported from SurveyMonkey into SPSS[30] software for analysis. SPSS databases were formatted, cleaned, and verified prior to the data analysis. The survey data was evaluated using techniques in SPSS including frequency tables and cross-tabulations. Statistically significant differences between subgroups of response categories are highlighted and discussed where relevant.

[29] Survey Money, https://www.surveymonkey.com/.
[30] Statistical Package for the Social Sciences, http://www-01.ibm.com/software/analytics/spss/.

Survey results

The results presented in this report are based on analysis of information provided by 690 individuals representing households in the market area. Unless otherwise indicated, the percentages reported are based on the "valid" responses from those who provided a definite answer and do not reflect individuals who said "don't know" or otherwise did not supply an answer because the question did not apply to them. Key statistically significant results ($p \leq 0.05$) are noted where appropriate.

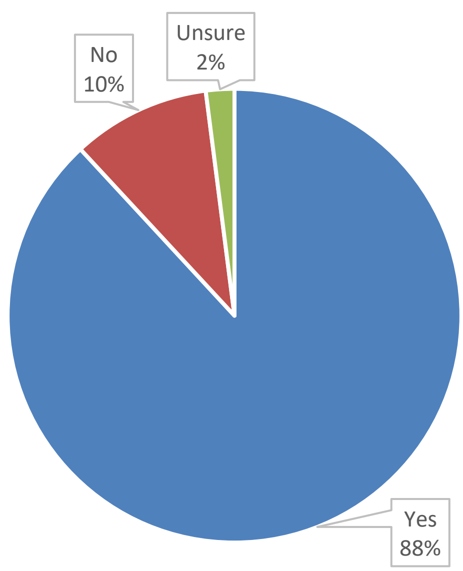
Internet connection and use

Respondents were asked about their use of the internet, including home internet connection providers, internet costs and satisfaction with their service. This information provides valuable insight into residents' need for internet services.

Internet usage

Most (88 percent) respondents have internet service, including home internet, personal hotspot, or cellular/mobile connections (Figure 40). Two-thirds of those without internet service said the cost is too high, and 20 percent said adequate internet service is not available at their location.

Figure 40: Have internet service



As shown in Table 12, respondents under age 35, those with a high school education or less, and those with a household income of less than $50,000 were somewhat less likely than their counterparts to have internet service.

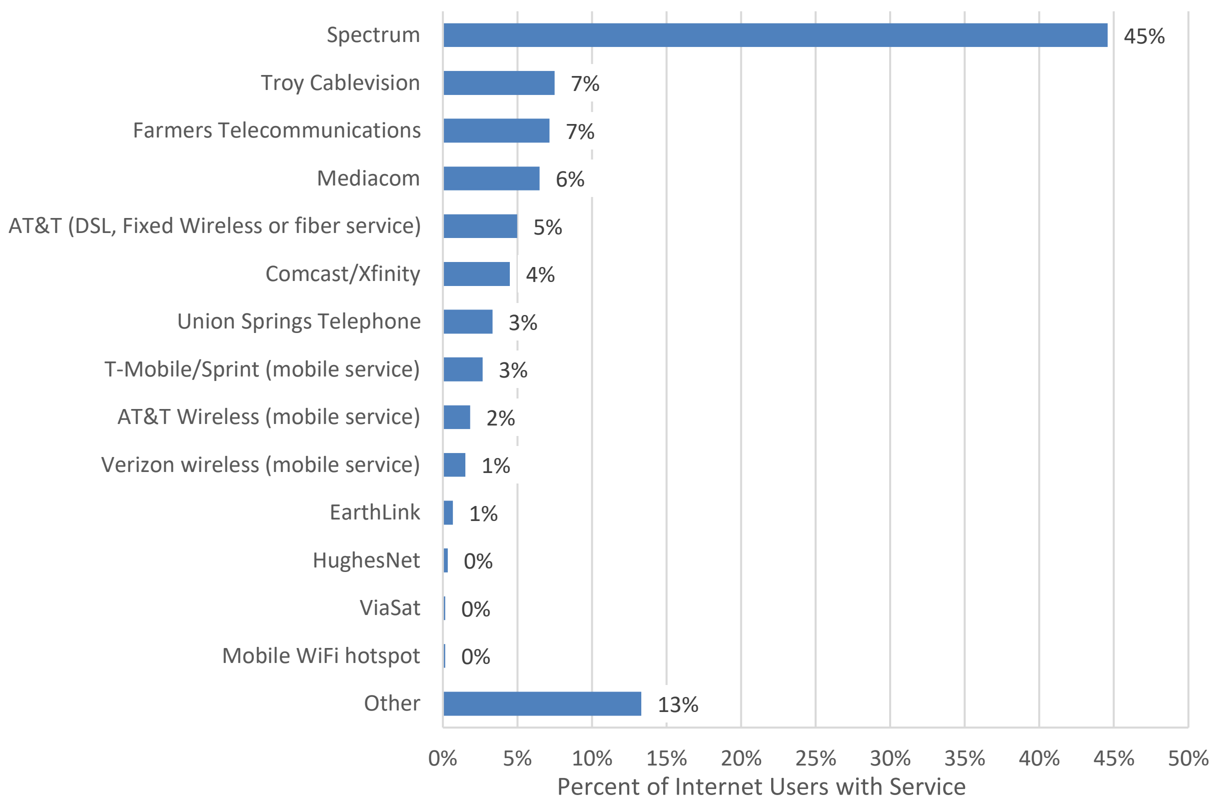
Table 12: Internet access by key demographics

	Yes	No	Not Sure	*Total Weighted Count*
TOTAL	**88%**	**10%**	**2%**	**690**
Own or Rent				
Own residence	**91%**	8%	1%	*400*
Rent residence	**86%**	12%	2%	*263*
Years at Residence				
< 5 years	**85%**	12%	3%	*324*
5+ years	**91%**	8%	1%	*363*
Respondent Age				
< 35 years	**82%**	13%	5%	*191*
35 to 44 years	**90%**	9%	1%	*300*
45 to 54 years	**90%**	9%	1%	*110*
55 years and older	**92%**	7%	1%	*88*
Education				
HS education or less	**84%**	13%	3%	*375*
Two-year college/tech	**94%**	4%	2%	*211*
Four-year college degree +	**92%**	8%	0%	*101*
Household Income				
Less than $25,000	**82%**	15%	3%	*240*
$25,000 to $49,999	**88%**	9%	3%	*226*
$50,000 or more	**96%**	4%	1%	*137*
Race/Ethnicity				
Black/African American, non-Hispanic	**87%**	11%	2%	*372*
White/European-American, non-Hispanic	**91%**	8%	1%	*254*
Other/more than one	**82%**	11%	7%	*55*
Gender Identity				
Female	**87%**	11%	2%	*530*
Male	**92%**	6%	2%	*150*
Household Size				
One household member	**58%**	0%	42%	*12*
Two household members	**86%**	9%	5%	*87*
Three household members	**89%**	10%	1%	*181*
Four+ household members	**89%**	10%	1%	*408*
Children in Household				
None	**81%**	0%	19%	*32*
1	**88%**	9%	3%	*191*
2	**90%**	9%	1%	*252*
3	**85%**	14%	1%	*128*
4 or more	**91%**	9%	0%	*85*
Employment Status				
Employed full-time	**88%**	8%	4%	*332*
Homemaker	**82%**	18%	0%	*72*
Unemployed/disabled or retired	**91%**	8%	1%	*168*
Other (including employed part-time, self-employed)	**88%**	11%	1%	*105*

Primary internet service provider

Spectrum is the leading ISP overall in the market area, with 45 percent of households with internet citing it as their primary provider (Figure 41). Other providers represent much smaller shares of the market, including Troy Cablevision (7 percent), Farmers Telecommunications (7 percent), Mediacom (6 percent), and AT&T DSL, fixed wireless, or fiber service (5 percent).

Figure 41: Primary internet service provider



Satisfaction with internet services

Respondents were asked to rate their satisfaction with various aspects of their internet service, using a scale where 1=Not at all satisfied and 5=Extremely satisfied. The mean importance of various service aspects is illustrated in Figure 42, while detailed responses are illustrated in Figure 43.

Overall, subscribers are moderately satisfied with their internet service. Specifically, subscribers were most satisfied with connection speed, connection reliability, and overall customer service; however, fewer than four in 10 were very or extremely satisfied with these aspects, while more than four in 10 were moderately satisfied. Approximately one-fifth of customers were not at all satisfied or only slightly satisfied with these service aspects. Customers were somewhat less satisfied with ability to bundle service (20 percent very or extremely satisfied) and price of services (22 percent very or extremely satisfied).

Figure 42: Satisfaction with internet service aspects (mean ratings)

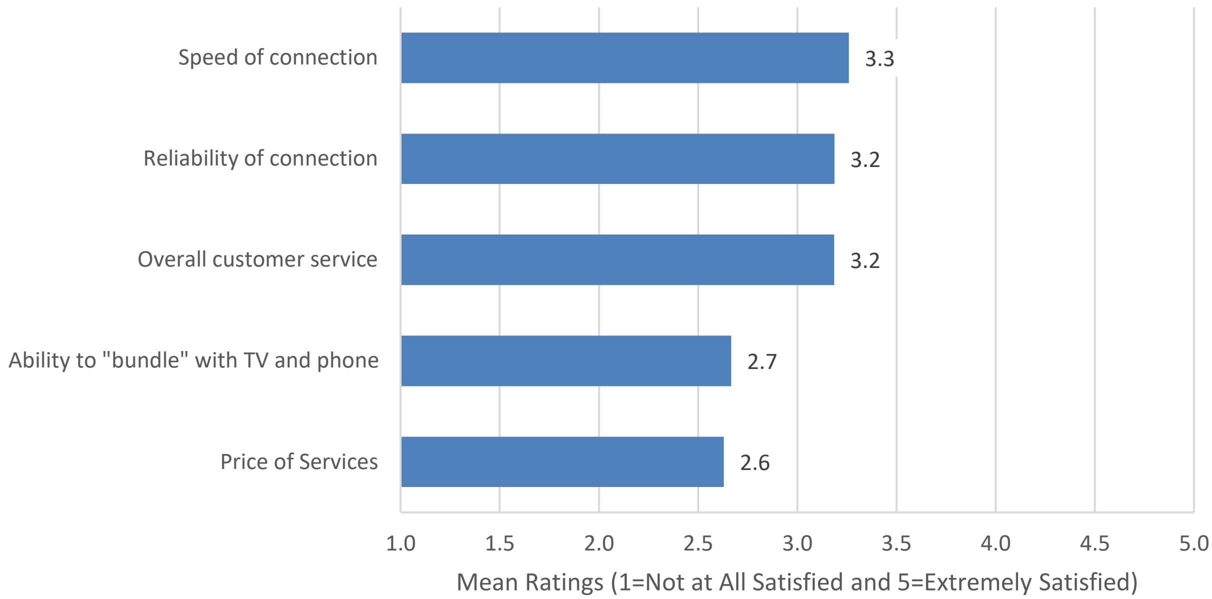
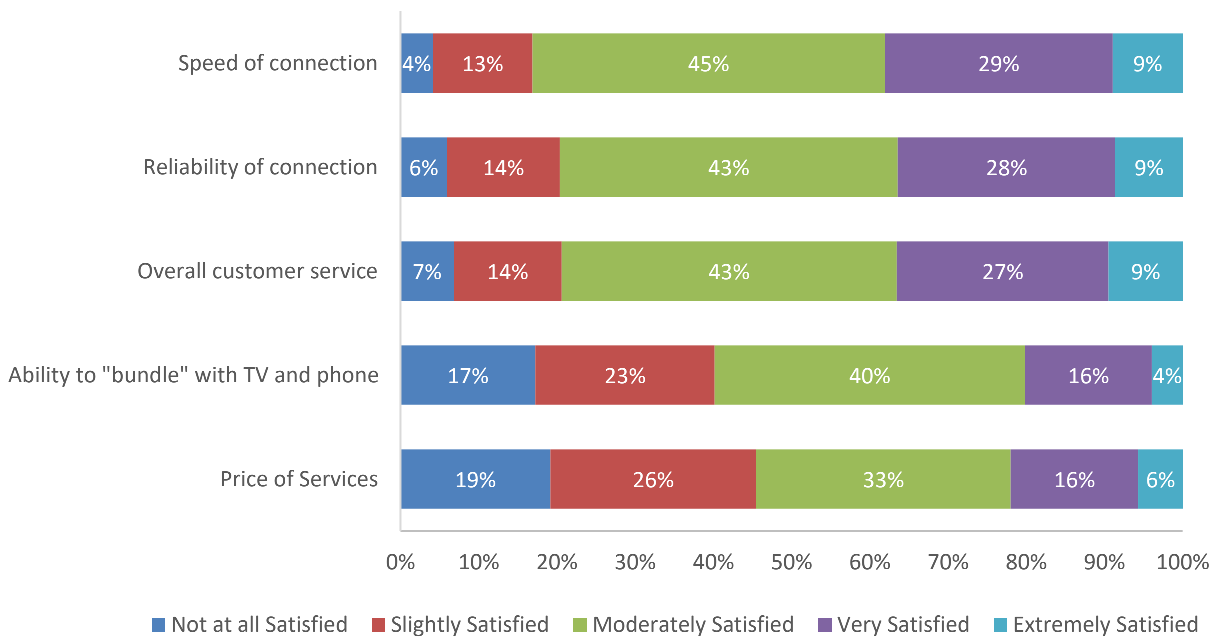
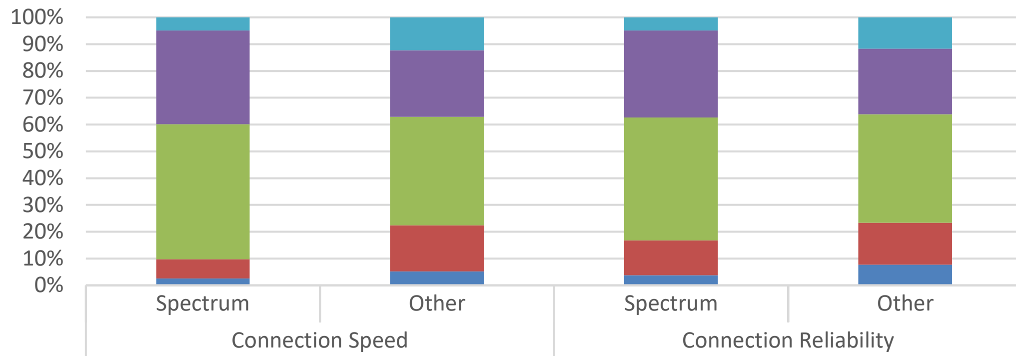


Figure 43: Satisfaction with internet service aspects



As illustrated in Figure 44, Spectrum subscribers were somewhat more satisfied with connection speed and reliability compared with subscribers of other internet services.

Figure 44: Satisfaction with connection speed and reliability by provider

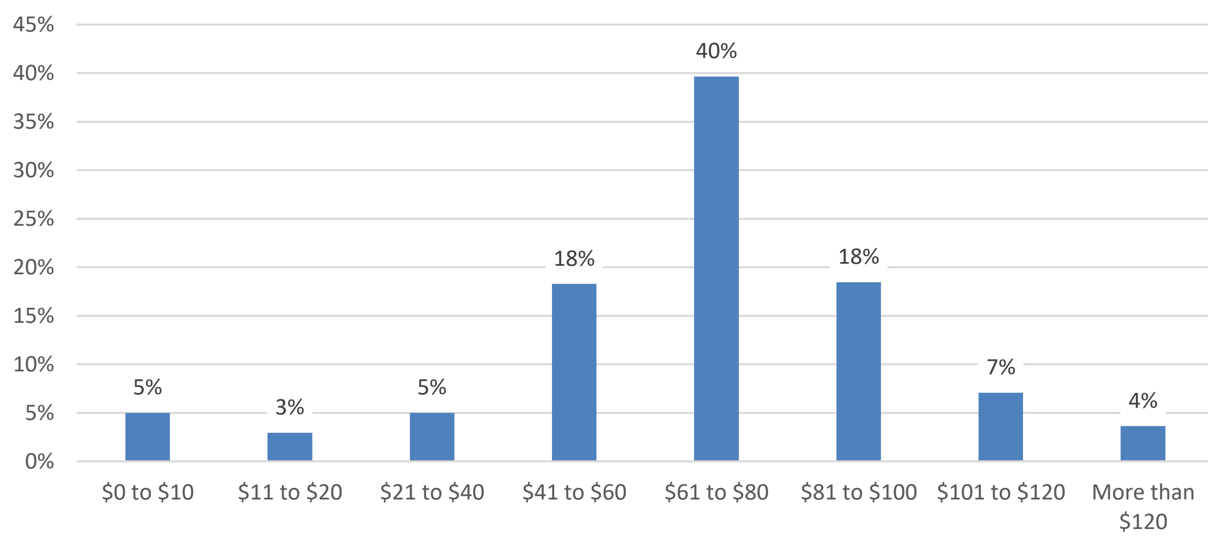


	Connection Speed		Connection Reliability	
	Spectrum	Other	Spectrum	Other
Extremely Satisfied	5%	12%	5%	12%
Very Satisfied	35%	25%	32%	25%
Moderately Satisfied	50%	40%	46%	40%
Slightly Satisfied	7%	17%	13%	16%
Not at All Satisfied	3%	5%	4%	8%

Internet service cost

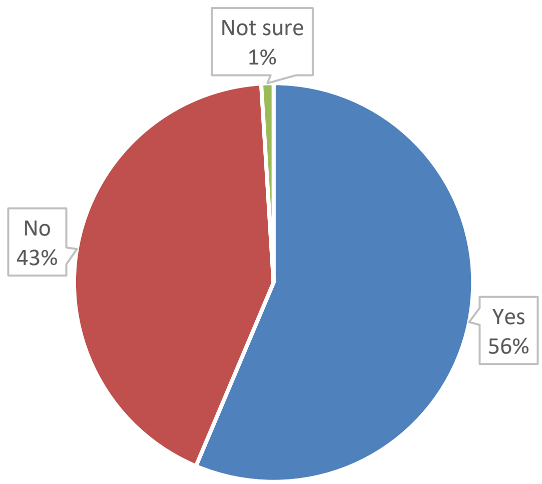
Respondents were asked the cost of their home internet service, as shown in Figure 45. Just 13 percent of respondents pay less than $40 per month for internet service, and 18 percent pay $41 to $60 per month. Another four in 10 pay $61 to $80 per month for internet, and approximately three in 10 pay over $80 per month. Cost for internet service does not vary significantly by provider or demographic characteristics of respondents.

Figure 45: Monthly price for internet service



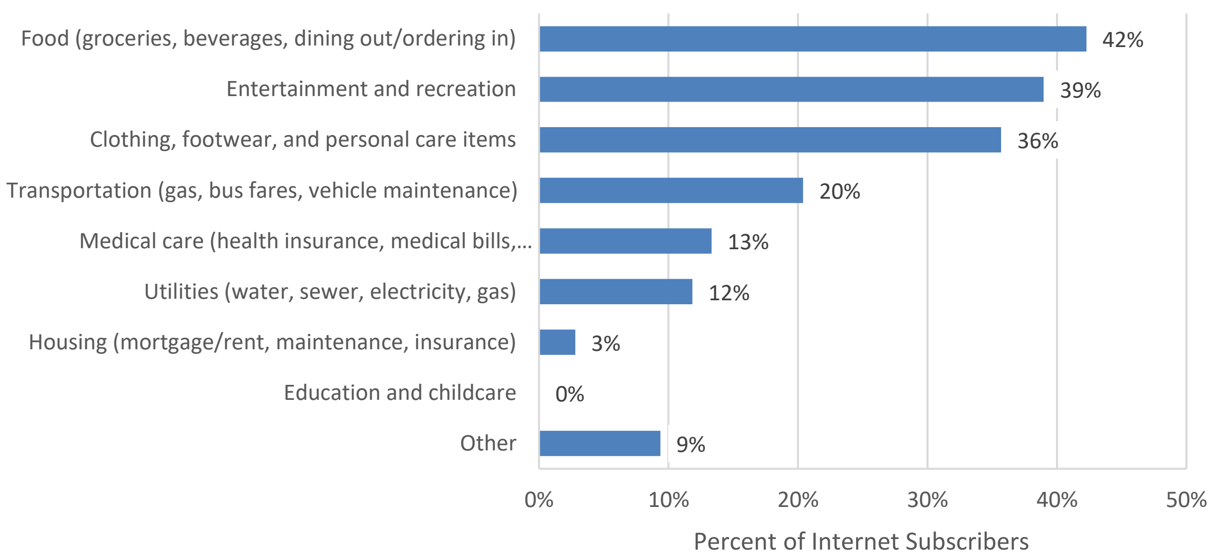
More than one-half (56 percent) of respondents have cut spending on other essential expenses to pay for internet service over the last year, as highlighted in Figure 46. (No statistically significant differences by provider type or household characteristics were found.)

Figure 46: Cut spending to pay for internet service



Specifically, more than four in 10 internet subscribers have cut spending on food items to pay for internet service, while 39 percent have cut entertainment and recreation expenses and 36 percent have cut spending on clothing, footwear, or personal care items (see Figure 47).

Figure 47: Expenses cut to pay for internet service



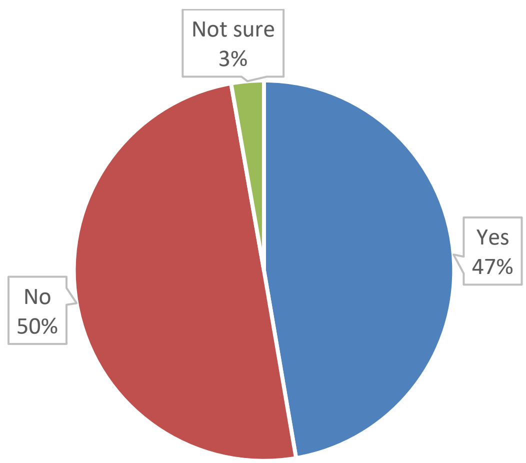
Broadband internet subsidy programs

This section explores awareness and use of various broadband internet subsidy programs across the region, which provides valuable insights about access for consumers.

Awareness of broadband subsidy programs

Nearly one-half (47 percent) of respondents have heard of broadband internet subsidy programs, while one-half were not aware of these programs (see Figure 48). As may expected, awareness was higher among those with internet than those without internet service (50 percent vs. 22 percent).

Figure 48: Heard of broadband internet subsidy programs



More than three-fourths (77 percent) of those aware of broadband internet subsidy programs (or 35 percent of all respondents) have heard of the Emergency Broadband Benefit program (Figure 49). Awareness of other subsidy programs is low.

Figure 49: Broadband internet subsidy programs have heard of

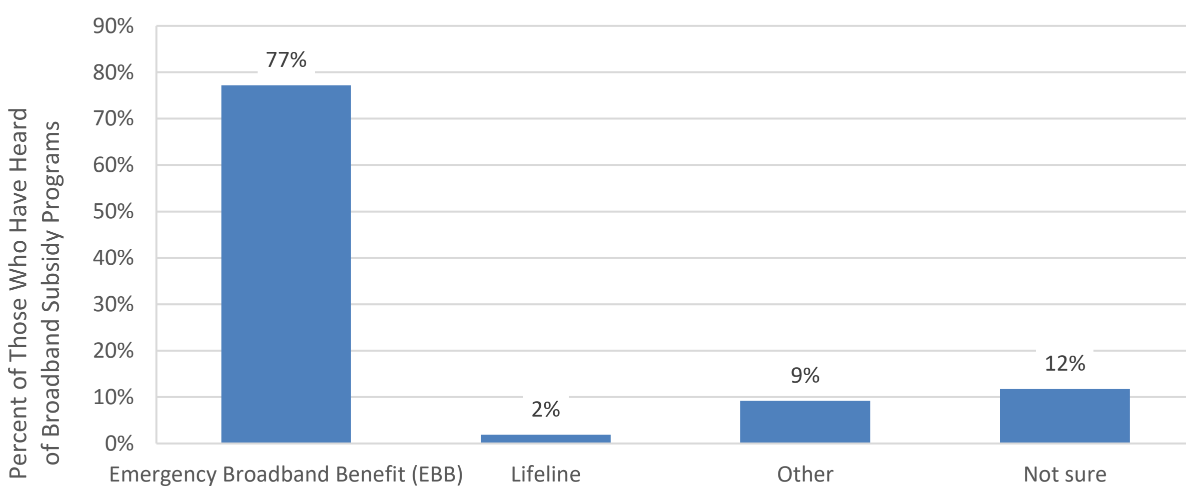


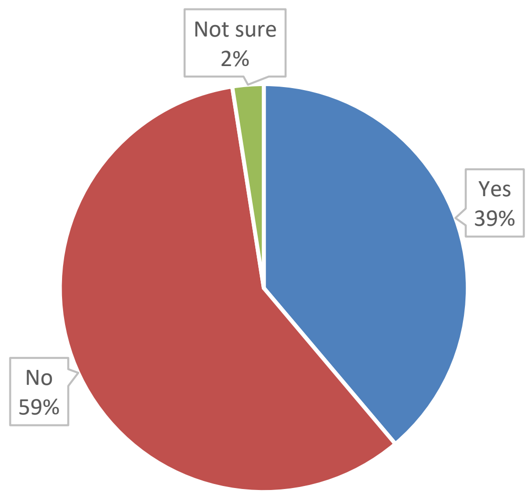
Table 13: Awareness of broadband internet subsidy programs by demographics

		Heard of broadband internet subsidy programs?			
		Yes	**No**	**Not sure**	***Total Count***
Have Internet Service	Yes	**50%**	47%	2%	*604*
	No	**22%**	76%	1%	*67*
	Unsure	**36%**	43%	21%	*14*
Primary Home Internet Service	Other	**50%**	48%	2%	*326*
	Spectrum	**52%**	46%	3%	*266*
Own or Rent Residence	Own	**50%**	48%	3%	*399*
	Rent	**44%**	53%	3%	*259*
Years Lived at Residence	Less than 5 years	**48%**	49%	4%	*322*
	5 or more years	**47%**	51%	2%	*360*
Respondent Age	< 35 years	**42%**	53%	5%	*189*
	35-44 years	**48%**	50%	1%	*298*
	45-54 years	**52%**	45%	3%	*110*
	55+ years	**48%**	48%	3%	*87*
Education	HS education or less	**46%**	52%	3%	*371*
	Two-year college or technical degree	**50%**	46%	4%	*210*
	At least four-year college degree	**49%**	50%	1%	*101*
Household Income	Less than $25,000	**51%**	44%	4%	*236*
	$25,000 to $49,999	**44%**	54%	2%	*226*
	$50,000 or more	**48%**	51%	1%	*137*
Race/Ethnicity	White/European American	**47%**	50%	3%	*370*
	Black/African American	**50%**	48%	2%	*251*
	Other/More than one	**40%**	55%	5%	*55*
Gender	Woman	**49%**	48%	3%	*527*
	Man	**43%**	54%	3%	*148*
Total Household Size (Adults + Children)	One HH member	**67%**	17%	17%	*12*
	Two HH members	**53%**	44%	3%	*87*
	Three HH members	**50%**	48%	2%	*180*
	Four or more HH members	**45%**	53%	2%	*404*
Children in Household	No Children in HH	**47%**	47%	6%	*32*
	Children in HH	**47%**	50%	3%	*651*
Number of Children in HH	None	**47%**	47%	6%	*32*
	1	**51%**	47%	3%	*190*
	2	**50%**	48%	2%	*251*
	3	**39%**	56%	5%	*126*
	4 or more	**45%**	52%	2%	*84*
Employment Status	Employed full-time	**46%**	51%	2%	*332*
	Homemaker	**43%**	56%	1%	*72*
	Unemployed/disabled or retired	**49%**	48%	2%	*166*
	Other (including employed part-time, self-employed)	**50%**	44%	6%	*103*

Applied for broadband subsidy programs

About four in 10 respondents have applied for broadband internet subsidy programs, as shown in Figure 50. Those with internet service were more likely than those without internet service to apply for a subsidy (43 percent vs. 7 percent).

Figure 50: Heard of broadband internet subsidy programs



Nearly nine in 10 (87 percent) of those who applied for broadband internet subsidy programs (or 30 percent of all respondents) applied for the Emergency Broadband Benefit program (Figure 51). Few respondents applied for other subsidy programs.

Figure 51: Broadband internet subsidy programs applied for

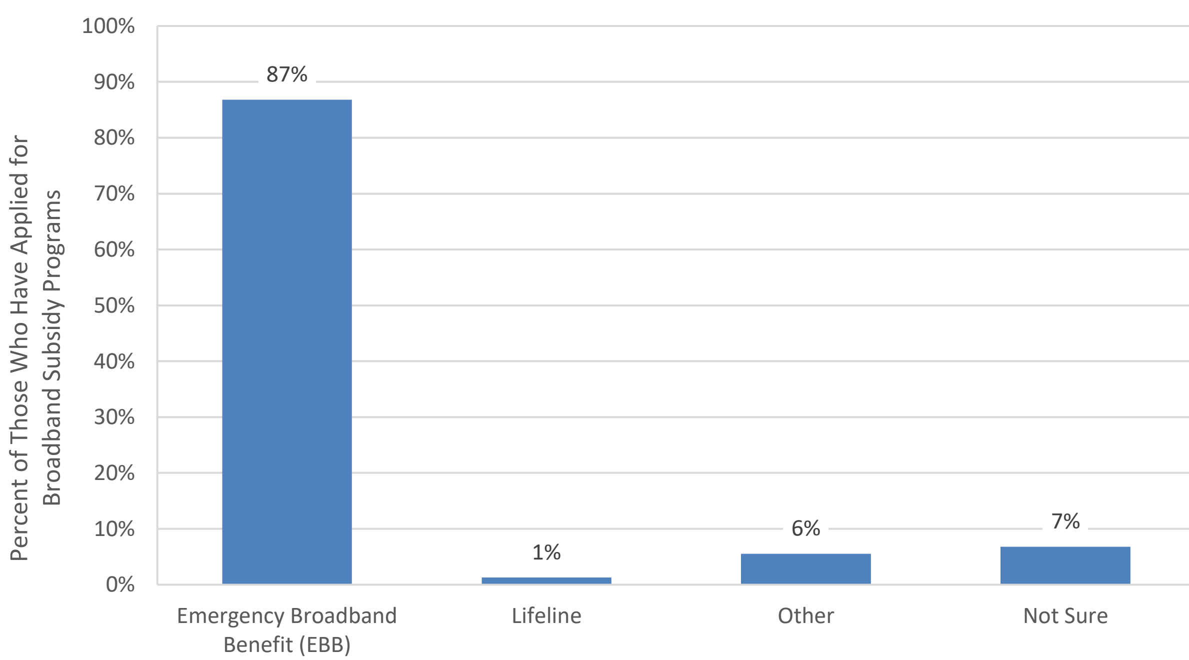
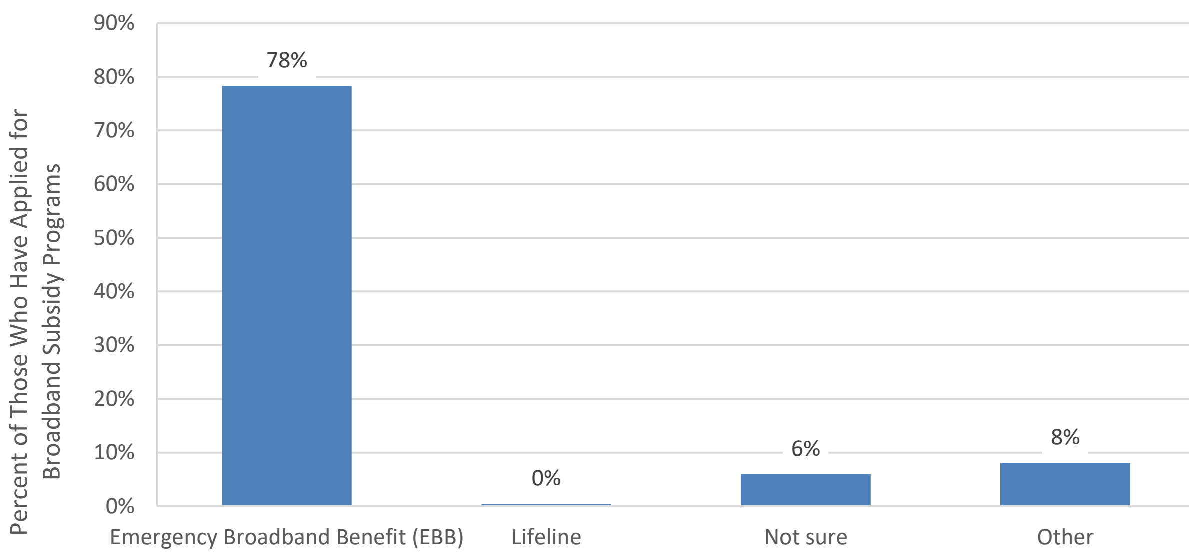


Table 14: Applied for broadband internet subsidy programs by demographics

		Applied for broadband internet subsidy programs? Yes	No	Not sure	*Total Count*
Have Internet Service	Yes	**43%**	55%	2%	*537*
	No	**7%**	87%	6%	*54*
	Unsure	**7%**	93%	0%	*14*
Primary Home Internet Service	Other	**39%**	59%	2%	*289*
	Spectrum	**48%**	50%	3%	*236*
Own or Rent Residence	Own	**38%**	59%	3%	*357*
	Rent	**41%**	57%	2%	*224*
Years Lived at Residence	Less than 5 years	**37%**	61%	3%	*284*
	5 or more years	**41%**	57%	2%	*319*
Respondent Age	< 35 years	**32%**	65%	3%	*160*
	35-44 years	**43%**	55%	2%	*261*
	45-54 years	**41%**	59%	0%	*98*
	55+ years	**36%**	58%	6%	*85*
Education	HS education or less	**38%**	59%	3%	*330*
	Two-year college or technical degree	**46%**	53%	2%	*179*
	At least four-year college degree	**31%**	67%	2%	*94*
Household Income	Less than $25,000	**45%**	52%	2%	*212*
	$25,000 to $49,999	**39%**	59%	3%	*196*
	$50,000 or more	**32%**	65%	3%	*123*
Race/Ethnicity	White/European American	**38%**	59%	3%	*327*
	Black/African American	**43%**	54%	3%	*226*
	Other/More than one	**27%**	73%	0%	*48*
Gender	Woman	**40%**	57%	2%	*470*
	Man	**35%**	62%	3%	*126*
Total Household Size (Adults + Children)	One HH member	**25%**	75%	0%	*12*
	Two HH members	**45%**	49%	5%	*75*
	Three HH members	**40%**	57%	3%	*162*
	Four or more HH members	**38%**	61%	2%	*355*
Children in Household	No Children in HH	**27%**	69%	4%	*26*
	Children in HH	**39%**	58%	2%	*578*
Number of Children in HH	None	**27%**	69%	4%	*26*
	1	**43%**	52%	4%	*166*
	2	**37%**	61%	2%	*232*
	3	**40%**	59%	1%	*108*
	4 or more	**38%**	61%	1%	*72*
Employment Status	Employed full-time	**35%**	63%	2%	*286*
	Homemaker	**34%**	62%	3%	*58*
	Unemployed/disabled or retired	**41%**	55%	3%	*155*
	Other (including employed part-time, self-employed)	**52%**	47%	1%	*93*

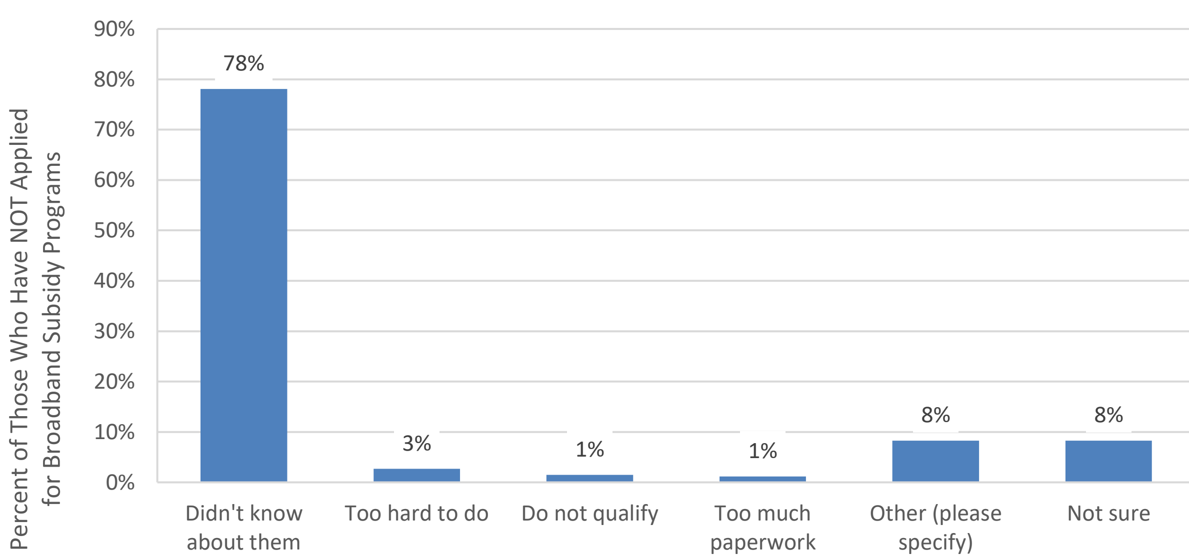
Similarly, most of those who applied for a broadband internet subsidy program use Emergency Broadband Benefit (78 percent), as shown in Figure 52.

Figure 52: Broadband internet subsidy programs used



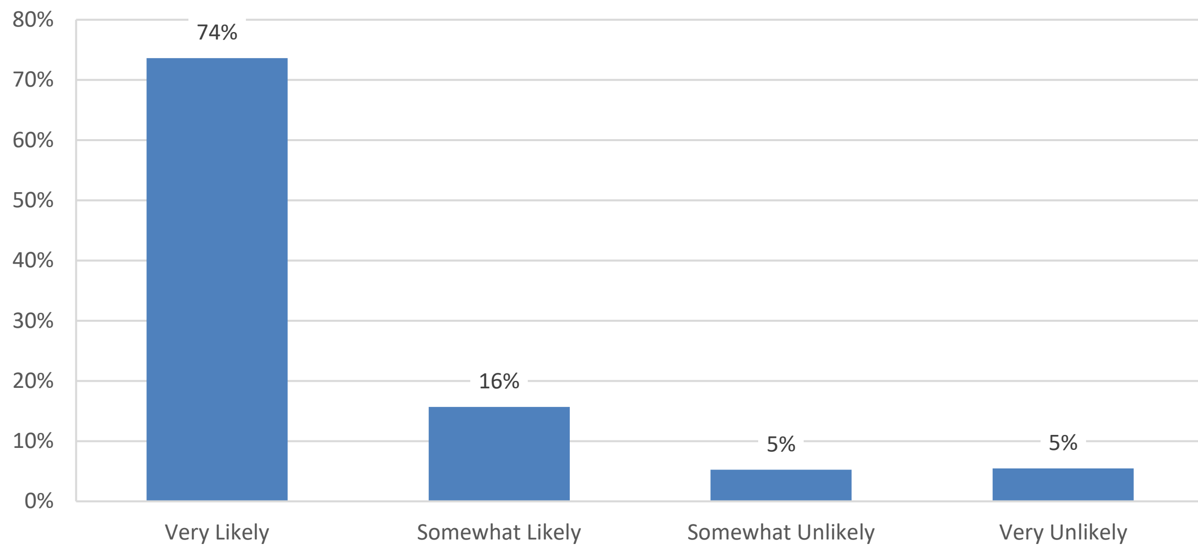
Among those who did not apply for a broadband internet subsidy program, the main barrier or reason cited is lack of awareness. More than three-fourths (78 percent) of those who have not applied for a subsidy program said they did not know about them (see Figure 53).

Figure 53: Reasons for not using broadband internet subsidy programs



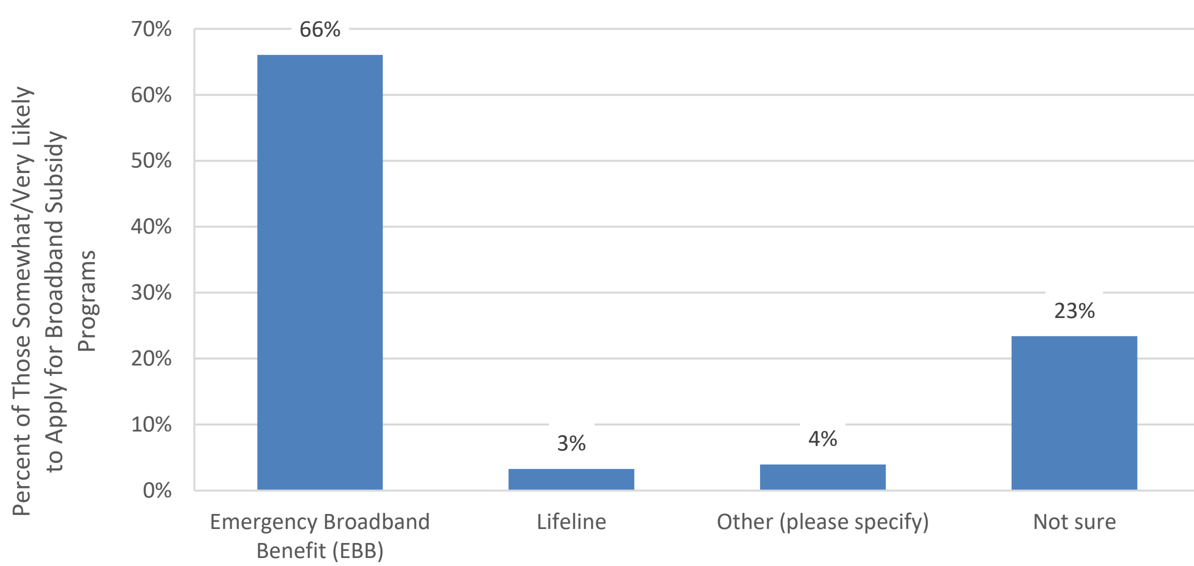
Nine in 10 respondents with an opinion said they would be very likely (74 percent) or somewhat likely (16 percent) to apply for a broadband internet subsidy program in the next 12 months (see Figure 54). One in 10 respondents would be unlikely to apply for a subsidy.

Figure 54: Likelihood of applying for broadband subsidy in next 12 months



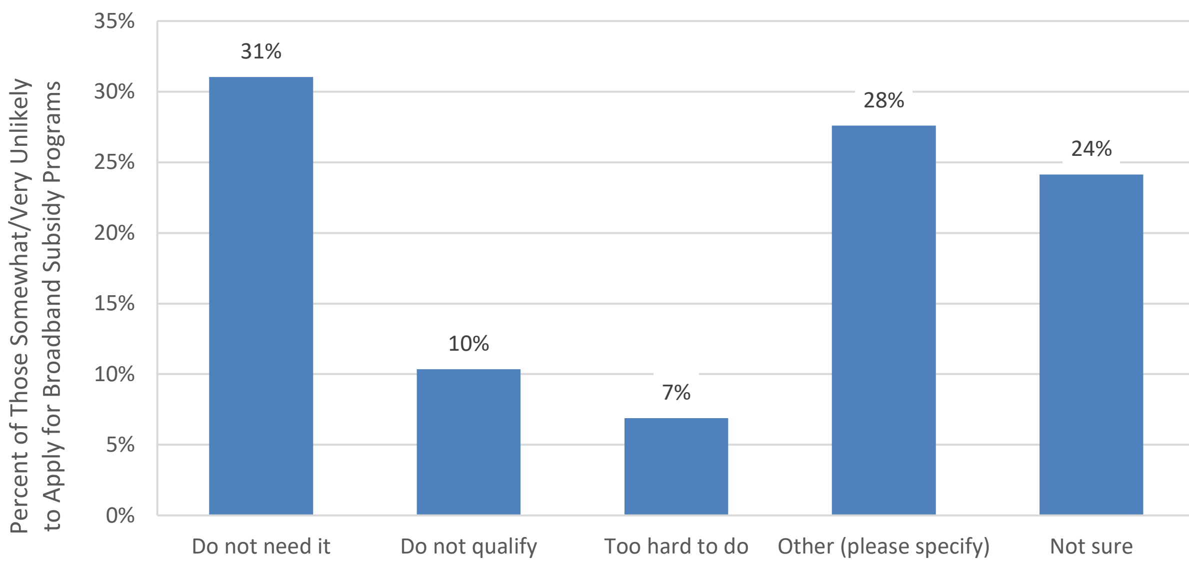
Two-thirds of respondents who would be very likely or somewhat likely to apply for a broadband internet subsidy program in the next 12 months would apply to the Emergency Broadband Benefit program. Another 23 percent of respondents are unsure to which program they would apply (see Figure 55).

Figure 55: Broadband internet subsidy programs likely to apply to



Nine of 29 (31 percent) respondents who are unlikely to apply to a broadband internet subsidy program in the next 12 months said they do not need it (see Figure 56).

Figure 56: Reasons unlikely to apply for broadband internet subsidy program

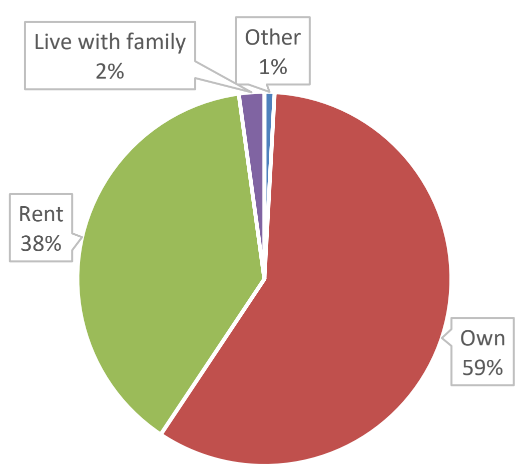


Respondent information

Basic demographic information was gathered from survey respondents and is summarized in this section. Several comparisons of respondent demographic information and other survey questions were provided previously in this report.

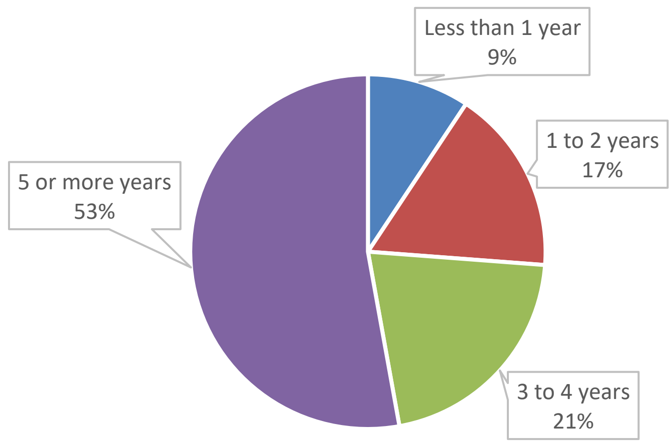
Fifty-nine percent of respondents own their residence, while 38 percent rent and three percent live with family or another setting (see Figure 57).

Figure 57: Own or rent residence



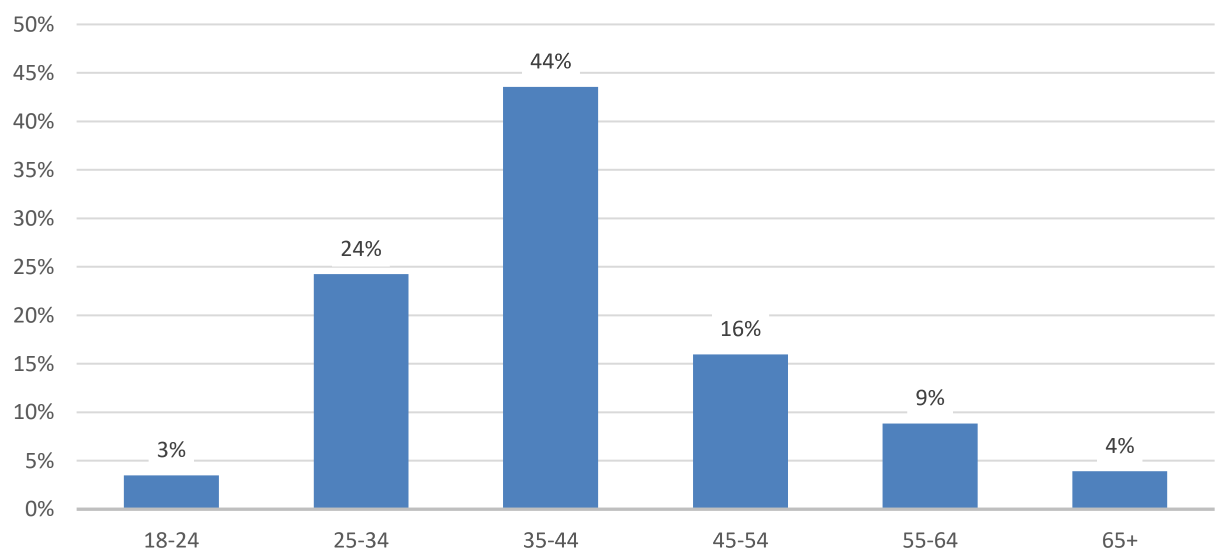
More than one-half (53 percent) of respondents have lived at their current residence for five or more years. Another 38 percent have resided at the home for one to four years, while nine percent have lived at the residence for less than one year (see Figure 58).

Figure 58: Number of years lived at current residence



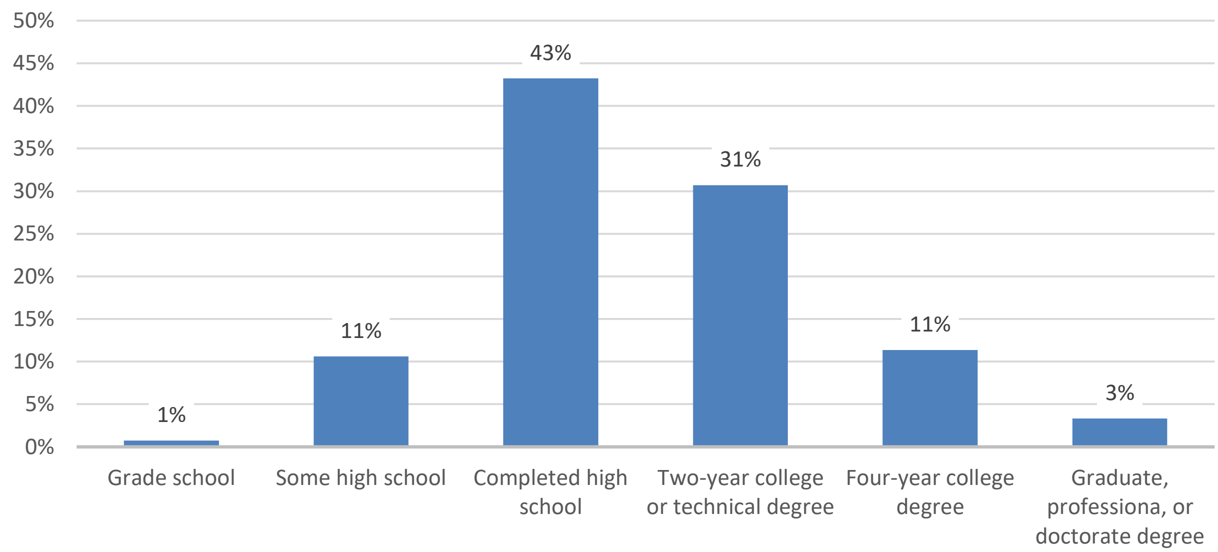
More than one-fourth of respondents are under age 35, and 44 percent are ages 35 to 44 years. Another 16 percent of respondents are ages 45 to 54 years, and 13 percent are ages 55 and older (see Figure 59).

Figure 59: Age of respondent



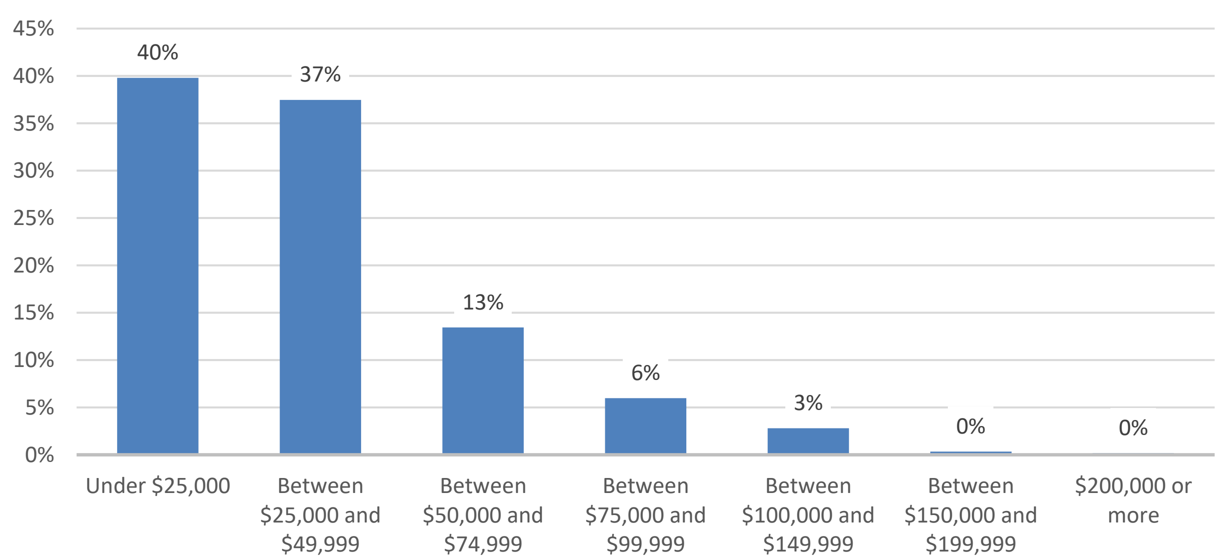
The respondents' highest level of education attained is summarized in Figure 60. More than one-half (55 percent) of respondents have a high school education or less, and 31 percent have a two-year college or technical degree. Another 14 percent of respondents have a four-year college degree or higher level of education.

Figure 60: Education of respondent



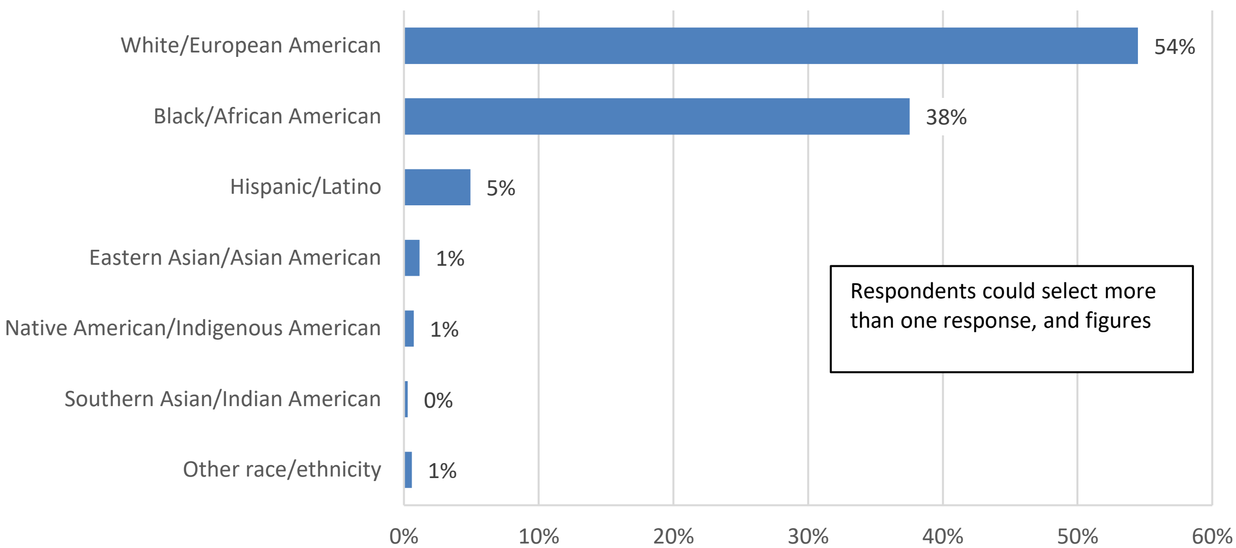
Four in 10 respondents have a household income of under $25,000, and 37 percent earn $25,000 to $49,999. Less than one-fourth of respondents have a household income of $50,000 or more (see Figure 61).

Figure 61: Annual household income



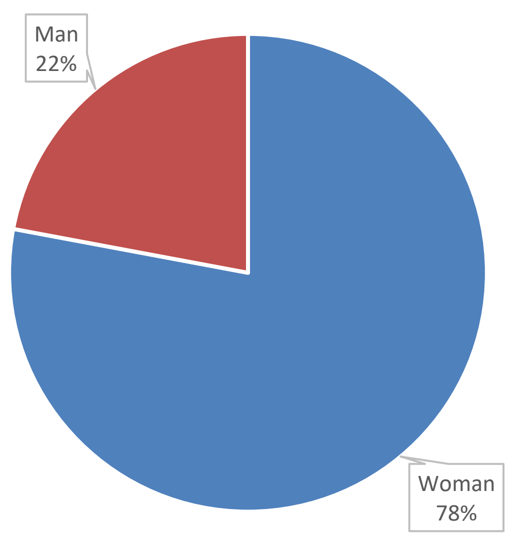
As illustrated in Figure 62, 54 percent of respondents are White/European American, and 38 percent are Black/African American.

Figure 62: Race/ethnicity



More than three-fourths (78 percent) of respondents are women, and 22 percent are men, as illustrated in Figure 63.

Figure 63: Gender identity



Respondents were asked to indicate the number of adults and children in their household. More than one-half of households have four or more members, and 26 percent have three household members. Just two percent of respondents live alone (see Figure 64). Almost all (95 percent) respondents have children living in the household (see Figure 65).

Figure 64: Total household size

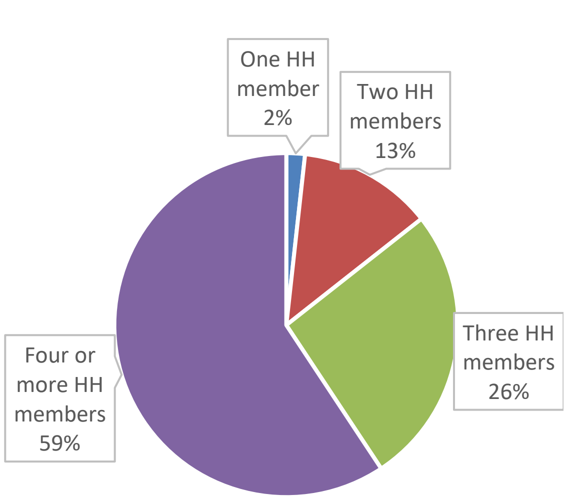
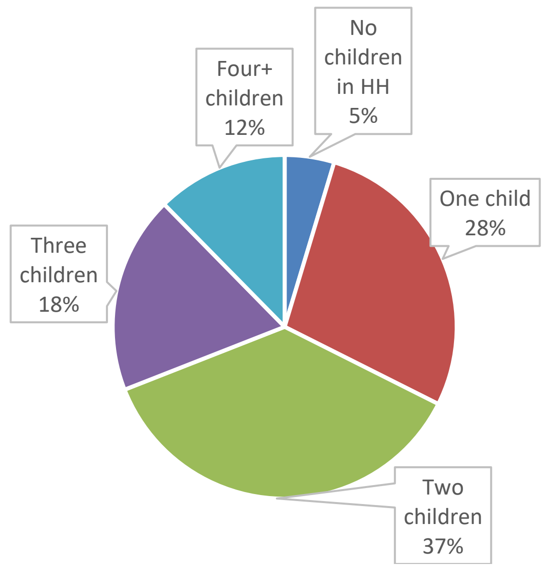
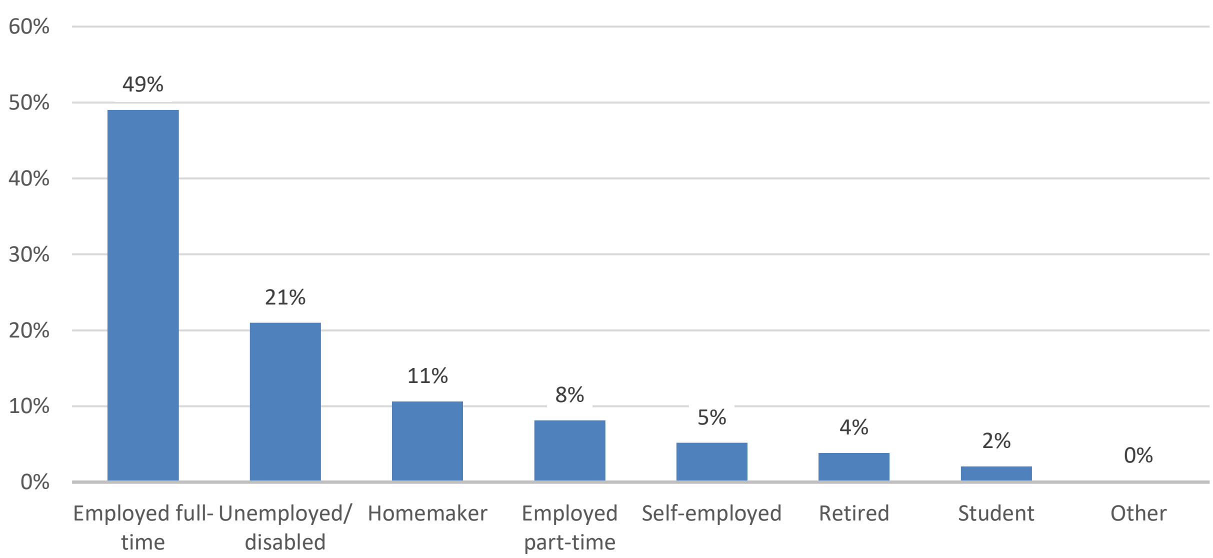


Figure 65: Number of children in household



Approximately one-half of respondents are employed full-time, and 13 percent are employed part-time (8 percent) or are self-employed (five percent). One-fifth of respondents are unemployed/disabled, and four percent are retired. Eleven percent of respondents are homemakers (see Figure 66).

Figure 66: Employment status



Appendix D: Economic impact analysis of broadband investments and increased adoption

Major investment in broadband infrastructure spending will result in the creation of jobs and increased earnings throughout the telecom supply chain and in the Alabama labor market. Further, increased broadband adoption *enabled* by increased broadband availability and programs to promote adoption will improve the efficiency and operations across the Alabama economy, increase workforce opportunities and earning power, and provide value to Alabama households.

This section analyzes the economic impacts of spending at different levels on broadband construction and deployment, as well as the impact over 10 years to household income, employment levels, household savings via increased telehealth usage. Lastly, this section uses a "consumer surplus" analysis to quantify the value of broadband in daily life to consumers beyond what is measurable via the impact on earnings, employment, and healthcare savings.

Key Context to the impact analysis

To ensure decisionmakers can derive the most value from this section of the report, it is essential to give an overview of the challenges and nuances inherent to measuring broadband impact across society, as well as the methodological approach that this report takes given the shifts and dynamism in our economy emerging from the COVID-19 pandemic.

First, this report addresses the major areas of impact and value inherent in broadband deployment and adoption, but is not comprehensive in its analysis of potential areas of value. For example, this analysis does not measure the impacts of broadband specific to farm income, the value created by enabling more remote learning opportunities, or the economic gains created by increasing housing values due to broadband deployment. These additional impacts are not included in the analysis predominantly due to a lack of credible and/or up to date academic research in those specific areas, however, the state will see positive economic movement in these areas as a direct result of broadband deployment and adoption.

Additionally, federal and state policy will be a major factor in the scale of economic impacts of broadband adoption in the coming years. For example, while Medicare and Medicaid customers have been allowed to bill their insurance for telehealth services to a greater extent during the pandemic, some of this access is being withdrawn, limiting potential savings via telehealth services. The difference in savings across the healthcare landscape in the next 10 years will depend significantly on federal rules around reimbursement, which will greatly impact the extent to which the healthcare industry prioritizes telehealth usage, and therefore promotes it (or doesn't promote it) as an option to patients.

Lastly, the volatility presented by the COVID-19 pandemic and a rapidly evolving economy will have impacts on the value of broadband that are not known now, but that researchers in the coming years may be better able to document. For example, increased remote work opportunities, increased automation, and an increased premium placed on information-sector jobs may mean that the value of having access to broadband in 10 years is significantly greater than what has been measured to date. Or, continued inflation in the construction sector because of the passage of the IIJA may mean that construction spending will ripple through the economy differently in the coming years than it did in the past.

Taken together, this analysis takes a generally conservative approach to estimating impact to ensure that Alabama policymakers are provided with pragmatic and attainable projections based on the best academic research to date and grounded in the context of the state. While there are many factors that interact to determine the ultimate scale of economic outcomes in the state of Alabama, all else equal, decades of research provide confidence in saying that broadband has the potential to generate substantial economic benefits for Alabama.

Analysis 1: Impacts of spending $1, $2, or $4 billion in broadband construction

This analysis estimates the economic impacts from the construction of broadband infrastructure at three different tiers: $1B, $2B, and $4B. These tiers do not represent just the amount of funding that could be provided by state and federal sources, but the total overall spending; in other words, if the state allocates $1B and that is matched against another $1B from other sources, the state should expect to see an impact in line with the $2B tier.

This analysis uses an input-output economic model developed by Emsi using data from the Bureau of Economic Analysis, the Census, and other sources. These input-output models are industry standard tools for this type of analysis, and takes an initial change in sales, jobs, or earnings and uses advanced data modelling to estimate how that change flows through the economy and between industries. (**Sales** are the industry's total annual gross receipts for products and services. A **job** is any position in which a worker provides labor in exchange for monetary compensation. **Earnings** for a region includes wages, salaries, supplements (additional employee benefits), and proprietor income.)

To understand the overall economic impact, this analysis first distributed the anticipated investment across the following industries (via North America Industry Classification System codes), with the following weights as informed by Brookings research and industry-accepted analyses.[31,32]

[31] The distribution of how this investment across broadband industries was based on the work of the Brookings Report *How federal infrastructure investment can put America to work* by Escobari, Gandhi, and Strauss from June 2021 which is based on the work of Pollin et al. (2020)

[32] Robert Pollin, Jeannette Wicks-Lim, Shouvik Chakraborty, and Gregor Semieniuk. Impacts of the Reimagine Appalachia & Clean Energy Transition Programs for Ohio: Job Creation, Economic Recovery, and Long-Term Sustainability, *PERI at University of Massachusetts Amherst*, October 2020, p. 107

NAICS	Industry	Weight
237130	Power and Communication Line and Related Structures Construction	25%
335921	Fiber Optic Cable Manufacturing	10%
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	15%
515210	Cable and Other Subscription Programming	10%
517311	Wired Telecommunications Carriers	20%
517312	Wireless Telecommunications Carriers (except Satellite)	20%

The charts below outline the total estimated benefits from a $1B, $2B, or $4B investment in broadband in Alabama.

The **initial effect** represents the initial change in sales, earnings, or jobs and does not include any ripple effects. The **direct effect** is the result from the initial expenditures of operations within that industry's supply chain. The **indirect effect** represents the impact on further supply chains – said another way, it estimates not the broadband infrastructure supply chain (which is the direct effect), but instead estimates the impact to supply chains of those providing services and products to the broadband infrastructure supply chain. Lastly, **Induced effects** are the total value of the follow-on effects of new earnings in the economy - e.g., a construction employee in a new construction job spending their paycheck in the region on food, clothing, and other goods and services. Lastly, these economic effects are for broadband deployment industries *within Alabama* and account only for the proportion of demand met locally within the state.

Economic Effects from Spending $1B on Broadband Construction			
Effect	**Sales**	**Jobs**	**Earnings**
Initial	$1,000,000,000	2,682	$226,385,482
Direct	$199,997,209	1,458	$69,301,362
Indirect	$56,763,371	454	$21,139,978
Induced	$312,187,814	2,731	$125,888,144
Total	**$1,568,948,394**	**7,325**	**$442,714,966**

Economic Effects from Spending $2B on Broadband Construction			
Effect	**Sales**	**Jobs**	**Earnings**
Initial	$2,000,000,000	5,363	$452,770,964
Direct	$399,994,418	2,917	$138,602,724
Indirect	$113,526,742	908	$42,279,955
Induced	$624,375,628	5,461	$251,776,289
Total	**$3,137,896,789**	**14,649**	**$885,429,932**

Economic Effects from Spending $4B on Broadband Construction			
Effect	**Sales**	**Jobs**	**Earnings**
Initial	$4,000,000,000	10,726	$905,541,928
Direct	$799,988,836	5,834	$277,205,448
Indirect	$227,053,485	1,817	$84,559,911
Induced	$1,248,751,257	10,922	$503,552,578
Total	**$6,275,793,577**	**29,299**	**$1,770,859,864**

Analysis 2: 10-Year economic impact of increased adoption

Increased *availability* of infrastructure is not the ultimate driver of broad-based economic impact. Adoption of broadband – whether in areas newly built or in areas with existing infrastructure – is the primary driver of broader economic benefits.

To estimate the full potential economic impacts of expanded broadband, this report uses a model based on increasing adoption across the entire state.[33] Specifically, this analysis estimates the impacts of reducing the gap in adoption in every county by a 25% (a conservative estimate) and by 50% (an optimistic estimate) over the next 10 years.

For example, a county with 60% adoption and 40% non-adoption would see their rate of non-adoption cut by a quarter, from 40% to 30%, in the conservative scenario, and cut in half, from 40% to 20% in the optimistic scenario. A county with 80% existing adoption would see their rate of non-adoption cut from 20% to 15% in the conservative scenario, or cut in half from 20% to 10% in the optimistic scenario.

In Alabama, reducing broadband non-adoption by 25% would result in 110,267 new households enrolled in a broadband plan after 10 years; reducing non-adoption by 50% would result in 220,534 additional enrolled households.

Clearly, broadband adoption cannot happen all at once; only *after* infrastructure is built can households become subscribers. The estimated adoption percentages for this analysis are outlined in the table below, based on adoption trends and projections outlined in previous research from Spell and Low (2021). These adoption percentages assume most new infrastructure is built in Years 1-5.[34]

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[33] Baseline data was derived from the 2019 ACS 5-Year Estimates.

[34] Spell, A., Low, S. (2021). Economic Benefits of Expanding Broadband in Select Missouri Counties. University of Missouri Extension, p 7. Retrieved at: https://mobroadband.org/wp-content/uploads/sites/44/2021/06/Exceed_BroadbandImpactReport_Jun2021.pdf

Estimated Rate at Which Households Adopt Broadband										
Year	1	2	3	4	5	6	7	8	9	10
% of HHs Adopted	0%	20%	40%	80%	90%	92%	94%	96%	98%	100%
Cumulative New HHs (Conservative Estimate)	-	22,053	44,107	88,214	99,240	101,446	103,651	105,856	108,062	110,267
Cumulative New HHs (Optimistic Estimate)	-	44,107	88,214	176,427	198,481	202,891	207,302	211,713	216,123	220,534

Benefits to household income

For those who adopt broadband, research indicates household income can increase due to a number of factors including access to online trainings, better job searching, access to goods and services, access to higher paying remote work, and opportunities for increased productivity.

However, research suggests that employment gains are seen predominantly in non-metro counties (Whitacre et. al., 2014).[35] Urban areas, on the other hand, see a negligible amount of employment gains with increased adoption, as adoption gains have largely been realized. As such, urban areas are excluded from this analysis.

Whitacre's 2014 research estimates that non-metro counties with high adoption levels show an 1.3% increase in median household income (MHI) each year. Spell and Low updated Whitacre's research in 2021 and made the following assumptions regarding the median household income (MHI) increases in *non-metro* counties:

- If a county shows adoption gains of 20 percentage points or more at the end of 10 years, MHI is estimated to increase by 1.3% for each year of adoption.[36]

- If a county shows adoption gains of less than 20 percentage points at the end of 10 years and therefore will not have as large of an impact, MHI is estimated to increase at half that rate, or 0.65%, for each year of adoption.

These rates of growth were applied to the number of new households that adopted broadband each year and is cumulative (i.e., a household that subscribed to broadband in year four will continue to see benefits in year five, six, seven, and so on through the 10-year period).

[35] Whitacre, B., Gallardo, R., & Strover, S. (2014). Does rural broadband impact jobs and income? Evidence from special and first-difference digressions. *The Annals of Regional Science*, 53(3), 649-670. Cited in Spell and Low (2021)

[36] Note: Only six counties in the high estimate (increase in adopted households by 50%) reached a threshold above 20% change in adoption rates – Greene, Lowndes, Marengo, Monroe, Perry, and Wilcox Counties. No counties in the low estimate (increase in adopted households by 25%) reached a threshold of above 20%.

The analysis then took the overall estimated additional income and calibrated it to historical Alabama data. Over the past 10 years, data from the American Community Survey indicates Alabama income has grown 3.6 percentage points *slower* than the rest of the nation. Therefore, to be conservative in this analysis, the estimated gains in median household income were calibrated to be proportional to Alabama trends. After applying this research and adjusting for Alabama the overall estimates for household income changes are below.

Impact of Adoption on Non-Metro Household Income after 10 Years		
	25% Reduction in Non-Adoption (Conservative Estimate)	**50% Reduction in Non-Adoption (Optimistic Estimate)**
Increase in Household Income	**$59,594,958**	**$132,479,351**

Impact on employment

Like household income impacts, employment increases relative to the degree the adoption rate changes, and increases are the most significant in non-metro counties. Importantly, based the research of Kolko (2012)[37] and Mack & Faggian (2013),[38] and cited in Spell and Low (2021), employment increases are not achieved across all sectors, but instead concentrated in knowledge-intensive industries.

Adapted from research by Spell and Low (2021), this analysis assumes employment to increase as follows:

- Employment increases by 3.4% in ten years if the initial adoption rate is below 60%.[39]
- Employment increases by 0.85% in ten years if the initial adoption rate is 60% or higher.

That said, this analysis reduces the ultimate employment impact projected due to the fact that a smaller share of the Alabama workforce participates in knowledge-based jobs. With fewer information-sector jobs and information sector employers in the state to begin with, the state cannot assume the same rate of growth in those sectors as other areas who are starting with a bigger existing cluster due to the network effects and ways in which knowledge-based firms create and employ talent pools that lead to employment growth via new firm creation in similar knowledge-based industries. In this analysis, the impact of employment gains are reduced by

[37] Kolko, J. (2012). Broadband and local growth. *Journal of Urban Economics*, 71(1), 100-113. Cited in Spell and Low (2021)

[38] Whitacre, B., Gallardo, R., & Strover, S. (2014). Does rural broadband impact jobs and income? Evidence from special and first-difference digressions. *The Annals of Regional Science*, 53(3), 649-670. Cited in Spell and Low (2021)

[39] Again, this only applies to six counties in Alabama - Greene, Lowndes, Marengo, Monroe, Perry, and Wilcox. Cited in Spell and Low (2021)

17.2%, in proportion to the smaller share of the workforce currently in knowledge-based jobs in Alabama versus the nation as a whole.[40]

The analysis estimates the following increase in non-metro employment:

Impact of Adoption on Non-Metro Employment after 10 Years ***Conservative Industry Impact***		
	25% Reduction in rate of non-Adoption	**50% Reduction in rate of non-Adoption**
Total	**3,101**	**3,801**

*Non-metro counties include those not in an MSA.

The increase in information-sector jobs in non-metro counties will also have a ripple effect over 10 years. To account for this, input-output modelling was used to estimate direct, indirect, and induced impacts of increasing the share of information-sector jobs in the economy. The following tables show these estimates.

Economic Effects from Non-Metro Job Increases (Conservative Estimate)		
Effect	**Jobs**	**Earnings**
Initial	3,101	$297,179,799
Direct	859	$41,646,127
Indirect	243	$11,341,017
Induced	2,252	$98,997,583
Total	**6,455**	**$449,164,525**

Economic Effects from Non-Metro Job Increases (Optimistic Estimate)		
Effect	**Jobs**	**Earnings**
Initial	3,801	$364,142,447
Direct	1,052	$51,040,331
Indirect	297	$13,897,765
Induced	2,760	$121,303,884
Total	**7,911**	**$550,384,427**

Impacts via increased telemedicine usage

Estimates for patient telemedicine savings are derived from four key areas identified in national research but calibrated to healthcare trends in Alabama. The national research used is as follows:

- *Patient Savings from Reduced Use of Emergency Departments* | Nord et. al. (2019)[41] show a telehealth consultation averages $45 and an ER visit costs $928, a savings of $883 per visit. The CDC (2017) estimates 43% of people go to the ER per year, and research by Spell and Low (2021) indicates that 50% of those who have adopted broadband will choose telehealth over a trip to the ER.

[40] While the focus of the analysis by Spell and Low (2021) is the State of Missouri, the original research conducted by Whitacre, et. al. (2014) was across the US.

[41] Nord, G., Rising, K., Band, R., Hollander, J. (2019). On-demand synchronous audio video telemedicine visits are cost effective. *The American Journal of Emergency Medicine*, 37(5), 890-894. Cited in Spell and Low (2021)

- *Patient Savings from Initial Health Consultation via Internet* | Nord et. al. (2019) show an average cost of $131 to urgent care and $108 to a physician office versus a $45 telehealth consultation. Like the methodology in Spell and Low (2021), this analysis assumes one urgent care and two physician office visits are replaced with telehealth consultations per household with adoption, resulting in a savings of $212 per year.

- *Patient Transportation Savings due to Telemedicine* |A Pew study (2018)[42] reports a roundtrip trip to a hospital from a rural location is 21 miles and 9 miles for an urban location. Rural locations in our analysis are those counties not in an MSA; urban counties are considered within an MSA. The mileage saved by reduced trips to the ER and by having health consultations via the Internet are multiplied by the IRS 2021 mileage rate of 56 cents per mile.

- *Missed Work Income Savings to Patient* |The same Pew study estimates lost time for travel to be 0.57 hours from a rural location and 0.35 hours from an urban location, plus an hour visit for services. Alabama's median hourly earnings were calculated for rural and urban locations using ASC 2019 data - $24.11 for urban locations (counties located in an MSA) and $18.54 for rural locations (counties not located within an MSA). Median hourly earnings were multiplied by the time savings and then multiplied again for the saved ER visits due to broadband adoption.

Importantly, this analysis reduces the estimated savings because the current rate of telehealth participation in Alabama is lower than the nation as a whole. During the peak of the pandemic, from June to November 2020, telehealth was used the least in the Southern region of the United States, with 20.4% of all visits conducted via telehealth compared to 30.2% nationwide (Demeke, et. al., 2021).[43] This analysis assumes that usage of telehealth in Alabama will be less to a proportional degree moving forward, and healthcare savings estimates are reduced to 67.5% of what could be expected nationally.

The findings of this analysis are as follows:

[42] Lam, O., Broderick, B., Toor, S. (2018). "How far Americans live from the closest hospital differs by community type." The Pew Research Center. Cited in Spell and Low (2021)

[43] Demeke HB, Merali S, Marks S, et al. Trends in Use of Telehealth Among Health Centers During the COVID-19 Pandemic — United States, June 26–November 6, 2020. MMWR Morb Mortal Wkly Rep 2021;70:240–244. DOI: http://dx.doi.org/10.15585/mmwr.mm7007a3.

Telemedicine Benefits Over 10 Years		
	Conservative Estimate (25%)	**Optimistic Estimate (50%)**
Patient Savings from Reduced Use of Emergency Departments	$255,397,193	$510,794,385
Patient Savings from Initial Health Consultation via Internet	$142,601,082	$285,202,164
Patient Transportation Savings due to Telemedicine	$2,051,748	$4,103,496
Missed Work Income Savings to Patient	$9,110,137	$18,220,274
Total Savings	**$409,160,160**	**$818,320,320**

Impact measured via consumer surplus analysis

The value of broadband to the average household greatly exceeds what can be measured via household income and employment measures. For example, additional value can result in direct cash in a family's pocket in cases where a household saves money when a new fiber connection costs less than their previous internet connection, allows the household to stream entertainment at a lower cost than a Satellite TV service, or even allows a family to cut their landline. But there are also household benefits that do not have direct financial implications yet provide a measurable amount of value to a household; for example, the ability to video-chat with family, access greater educational or entertainment options, install new IoT technology, work from home more often (and therefore not commute as much, save maintenance costs on vehicles, spend more time with family, cook more home meals, etc.).

To assess the aggregation of quality of life and value to the household, economists frequently use a Consumer Surplus Analysis which seeks to quantify how much value a consumer derives from a service. The premise of this analysis is that if a consumer would pay more for a service than they currently are paying, they are deriving a quantifiable value from that service. For example, if a broadband connection costs $60 dollars a month, but the family would pay $250 a month because it provides them so much opportunity and value across their work and personal life, then one could say that the household is deriving $190 of surplus value each month from that service.

Analysis by Rembert et. al. (2017) suggests that each household has an annual added benefit from broadband worth an estimated $1,850 per year.[44] Given that this research was before household benefits and opportunities via broadband increased even further as a result of the pandemic, the estimated impact should again be considered conservative.

To calculate the benefit under each adoption scenario, the number of households adopting broadband each year was multiplied by the assumed value.

[44] Rembert, M., Feng, B., Partridge, M. (2017). Connecting the Dots of Ohio's Broadband Policy. Swank Program in Rural-Urban Policy, Ohio State University.

Consumer Surplus After 10 Years		
	25% Change in Adoption (Conservative Estimate)	50% Change in Adoption (Optimistic Estimate)
Total	**$ 1,448,357,150**	**$ 2,896,714,300**

Summary of Analysis 2: 10-Year impacts of increased broadband adoption

Should an additional 110K to 220K households enroll in broadband (corresponding to the 25% and 50% goals), Alabama could conservatively see a $60M to $132M increase in household income, as well as 6.5K to 7.9K new jobs that result in $449M to $550M of additional earnings. Healthcare savings with telemedicine adoption could range from $409M to $818M, and the consumer surplus value over 10 years is $1.4B - $2.9B. In sum, the total economic impact over 10 years (not including the construction impact) will be between $2.4B and $4.4B.

Summary of 10 Year Economic Impact Benefits		
	Conservative Estimate	**Optimistic Estimate**
Additional Adopted Households	110,267	220,534
Additional Employment	6,455	7,911
Additional Household Income	$59,594,958	$132,479,351
Earnings from additional employment	$449,164,525	$550,384,427
Telehealth Savings	$409,160,160	$818,320,320
Consumer Surplus Value	$1,448,357,150	$2,896,714,300
TOTAL ECONOMIC BENEFIT	**$2,366,276,793**	**$4,397,898,399**